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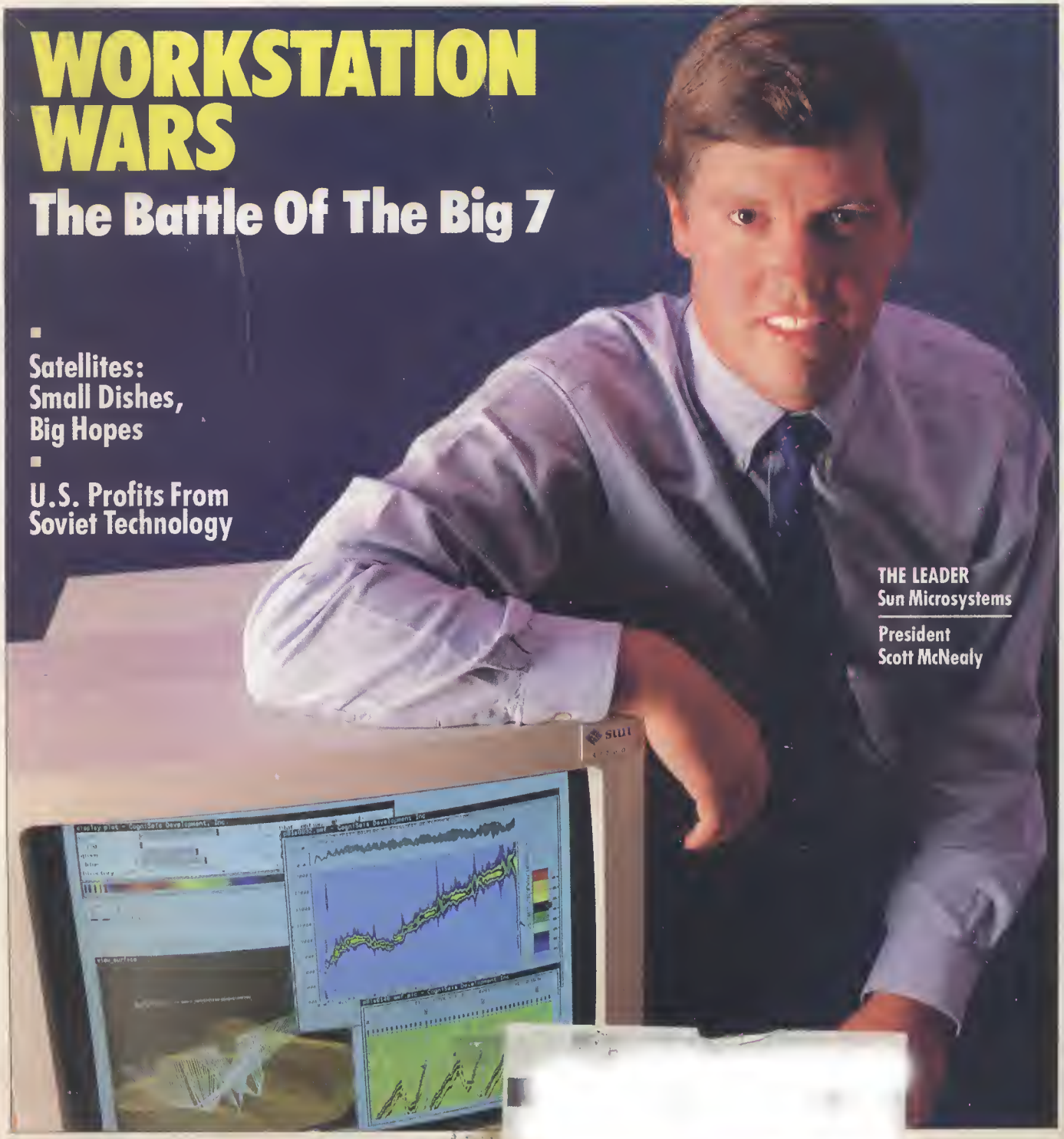

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- Satellites: Small Dishes, Big Hopes
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HIGH TECHNOLOGY BUSINESS

FEATURES

COLUMNS

MARKETWATCH

DEPARTMENTS

Workstation makers slice up the market, p. 22.

Airline reservation systems take off, p. 36.

Soviet technology hits the U.S., p. 31

Cover photograph by George Steinmetz.

Using new technologies, an advanced solid-state laser prototype has been produced that is more efficient and more readily scaled from low to high power than currently available models. The Hughes Aircraft Company-built prototype uses optical phase conjugation, ensuring that all light waves emitted are in phase, compensating for aberrations and distortions in a laser beam. Also, the new laser material used, co-doped gadolinium scandium gallium garnet, approximately doubles the efficiency and energy storage capacity of the laser. A follow-on contract has been awarded to Hughes for the second and third stages of the U.S. Air Force's Medium Energy Source (MES) program. Future applications of the new laser include communications, range finding, and target designation.

The United Kingdom Infrared Telescope (UKIRT) in Hawaii was the first to use a new infrared focal plane array, which has caused a technological revolution in infrared astronomy. The Hughes-built microchip "sandwich" provides sharp, fast infrared images of our solar system and the galaxies. Astronomers can now obtain a better look inside mysterious clouds of dust and gas, known as nebulae, to learn more about the life cycle of stars. The array also produces, for the first time, fine-grain infrared images of objects within nebulae that were previously hidden.

A processor utilizing advanced microchips will offer processing power equal to 200,000 desktop personal computers. This new programmable signal processor (PSP) uses very large scale integrated (VLSI) circuits called gate arrays to pack this power into a 65-pound box, which measures just one cubic foot in volume. By comparison, these 200,000 personal computers would weigh roughly 3.4 million pounds, without any add-on memory cards, disk drives, or monitors. If stacked 20 units high, the 200,000 personal computers would fill a room approximately 144 x 120 feet. The PSP is being built by Hughes for the APG-70 radar system to be used aboard the U.S. Air Force F-15.

The nation's newest weather satellite has completed the U.S. weather-watch system. The Geostationary Operational Environmental Satellite (GOES) H, launched into orbit over the Atlantic seaboard, provides data for meteorologists to predict and monitor storm fronts threatening the East coast. Designed and built by Hughes for the National Oceanographic and Atmospheric Administration, GOES H carries two experimental payloads: a space-environment monitor (SEM) for solar-wind measurements, and a receiver designed to aid international search and rescue missions.

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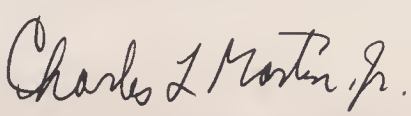
Our Computers column is intended to help you with your business strategies. As an example, read this month's column on computer standards. In future columns, you'll find practical advice as well as help with long-range planning.

This information doesn't come from an ivory tower; Andy uses or has used everything about which he writes. He spends much of his time in a test lab with a dozen IBM PCs, a dozen ITT 286-compatible computers, and two dozen Apple Macintoshes, as well as a half-dozen laser printers and as many networks. (He also has three computers at home.) Andy knows the problems business people have with computers, because he's already experienced those problems.

As you'd expect, he also spends time with computer-company leaders, discussing strategies and products before they're introduced.

We're delighted to have Andy in our pages and, as always, we're interested in your views of new features as we add them, as we continue to provide you with useful information about technological developments. If you have an area you'd like Andy to address or if you want to comment on the column, you can write to him in care of HIGH TECHNOLOGY BUSINESS. (Write to: Computers, HIGH TECHNOLOGY BUSINESS, 214 Lewis Wharf, Boston, MA 02110.)



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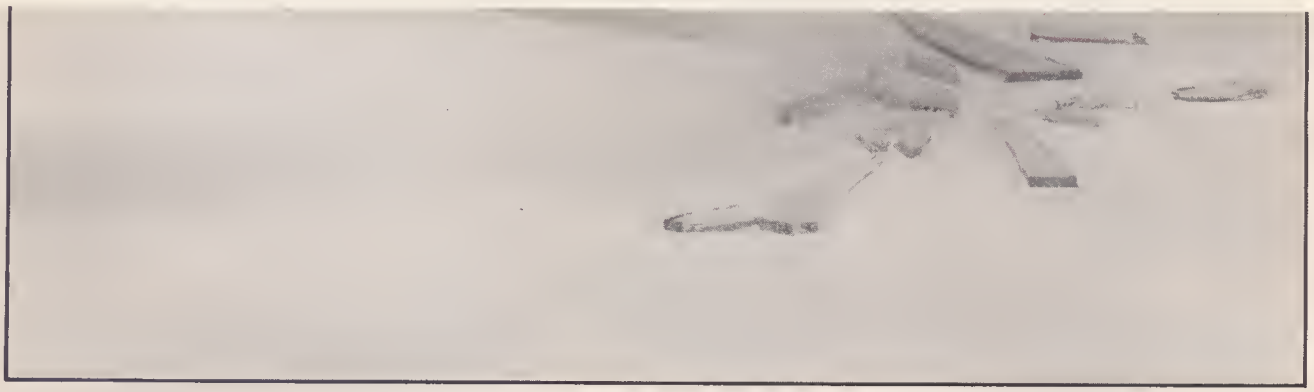

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Seybold Begins Computer Column

LOOK ON PAGE 15 this month, and you'll find a new name as Andrew Seybold begins writing our regular Computers column.

When Andy and I first met many years ago, he proudly showed off his car trunk full of electronic gadgetry and communications equipment. That was long before Apple or IBM introduced their personal computers, which changed the way businesses operate.

Having been involved with larger computers in his youth—Andy worked for his father, John Seybold, a noted pioneer in computerized typesetting—an immediate attachment to the personal computer was very natural.

Andy started with an original Apple, graduated to an Apple II, and ultimately began teaching business people how to use the then-new IBM PC. When the computer market took off, Andy began a monthly newsletter, *Andrew Seybold's Outlook on Professional Computing.* The newsletter offered business users product reviews, news, and an informed perspective on trends.

That newsletter grew and recently became part of Infotechnology Publishing Corp., which also publishes HIGH TECHNOLOGY BUSINESS. The newsletter still deals with the professional application of computers.

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Application is All

AS A BUSINESS consultant for the past 30 years, I have been involved in seeking out, evaluating, and recommending technologies for application. In order for technology to be helpful to the economy, it must be applied in the marketplace. The record of application of useful technologies is perhaps one in ten.

My first issue of HIGH TECHNOLOGY BUSINESS does not include a section dealing with technology application. You may say this is something for someone else to worry about, but the future of everyone in America depends on people learning how to apply the new technologies and having some access to the means of doing it.

Most useful technologies are invented by individuals, not by the research-and-development departments of major corporations. There are many reasons why technologies do not reach the marketplace. Among these are the "not-invented-here" syndrome, lack of capital, or the fact that the new products would replace an existing product for which the capital investment has already been paid. Other reasons include interest rates on loans that exceed the return-on-investment the new business could generate (now true of almost everything), and break-even points being more than 18 months away.

We now have a new obstacle, the Tax Reform Act, which, starting in 1988, will tax profits from investments at the same rate as regular income. That comes close to destroying the incentive for anyone to invest capital in business, except possibly Karl Marx.

R.W. Lillie
Granada Hills, Calif.

More Than a Resale

RE: THE ARTICLE on Ada in your September issue ("Military Software's New Market," p. 43):

The author stated that Harris simply resells an Ada compiler from another vendor. This is only partially true. The front-end of the Harris Ada compiler was purchased from Verdix and then significantly enhanced by Harris. The part of the compiler responsible for code generation is an expert system developed completely by Harris; this system allows Ada to be quickly retargeted to other computer systems and also supports rapid prototyping.

In addition, Harris has integrated the Ada compiler into a Minimal Ada Programming Support Environment as recommended by the Department of Defense. The Harris environment provides special tools, such as configuration control and management of source, object, and program specifications, in addition to documentation tools, program-management tools, static-analysis tools, etc.

This is important because Ada is more than a language. It is a complete software-development system that implements key principles of software engineering designed for large-scale program design, documentation, implementation, execution, and maintenance.

W.J. Marlow
Director, Aerospace/Defense
Harris Corp.
Fort Lauderdale, Florida

An Untapped Resource

THE ISSUES covered in the April article "Wanted: Hands-on Engineers" by Roland W. Schmitt (p. 10) are, in my view, the most important ones to be addressed if the United States is to regain an international competitive edge in productivity and technology.

There is one further step that I should like to suggest. A largely untapped human resource in our technical community is the large cadre of retired engineers and engineering managers. I fully share Schmitt's concern that the industry experts made available to universities by industry are often not those likely to bring the very best practical and advanced competitive management thinking and technical know-how to the campus. In our rush to make room for younger technical leadership in industry, are we perhaps overlooking the potential resource represented by the hundreds of engineers who retire each year? Many of them are highly motivated to contribute further to their profession and quite capable of imparting their knowledge to the next generation, probably at a cost readily affordable in an academic setting. This resource seems to be only rarely and inefficiently used by the companies where these retirees built careers—much less by universities that could benefit from the ripened fruit of these careers.

Gary Nothmann
Principal Engineer
Xerox Corp.

Smart Card Approval

I SURE LIKE the idea of the new smart cards with identification, medical records, banking, and other information on a computerized system ("Smart Cards Get Smarter," September, p. 35). I wonder why the government has not latched onto the idea for military installations, for identification and medical use? This year, the military installation where I receive medical treatment installed a computer system for the pharmacy. Instead of filling out paperwork every time a refill is needed, why not use a computer card? It would cut costs and time.

Mrs. June Underwood
Burkburnett, Texas

Send the Robots

IN THE WAKE of the Challenger tragedy, the U.S. space program is in disarray. NASA has delayed and postponed already neglected robot planetary missions even further in an effort to funnel every spare penny into rebuilding the shuttle program.

Man will journey into space. But our senses can travel farther and sooner if they are not tied to bone and sinew. Our human senses can be supplanted by electronic ones of higher sensitivity. Impossible or prohibitively expensive journeys can become feasible if we use robot technology. NASA should send our surrogate senses to the stars.

Dave Trott
Denver, Colorado

We welcome comments from our readers. Address letters to Editor, HIGH TECHNOLOGY BUSINESS, 214 Lewis Wharf, Boston, MA 02110. We reserve the right to edit letters for length and clarity.

New Developments

Issues, products, and advances that help create new opportunities for high-tech businesses

- New medical diagnostics need no lab
- Hand-held computer breaks the laptop limit
- French lightning conductor reaches out to bolts

Super VHS Goes Professional

SUPER VHS may be the hottest new video format since VHS and Beta battled it out in the early 1980s. On the market this year, the new high-quality cassettes threaten to remake the home video market. But unlike its predecessors, Super VHS may have an equally great impact among video professionals. Super VHS offers obvious advantages for home users, but will have to replace a popular existing standard. Many professionals, on the other hand, have long been unhappy with ¾-inch U-Matic, the current standard for industrial production.

Super VHS promises to give business users high quality in an accessible package. It offers a better image at a significantly lower price than that of U-Matic equipment. A spokesman for Toshiba, one of the companies supplying the new format, says, "Three-quarter-inch U-Matic now has a rival that's a lot more convenient to use."

Video professionals are interested, but cautious. Scott Jacobs, a principal at IPA, a video post-production house in Chicago, predicts Super VHS "will be terrific as an off-line system" for preproduction. But he adds, "We still don't know whether it will work in a production situation."

By squeezing more signal information onto each cassette, Super VHS approaches the quality of one-inch broadcast video. If the new format catches on with consumers, economies of scale should hold down the costs of professional equipment.

STEVEN MARK NEEDHAM

Super VHS will challenge today's professional video formats.

Indistinguishable from conventional VHS in use and appearance, Super VHS decks can play standard VHS cassettes, although VHS decks can't handle Super VHS tapes. JVC, which invented the format, introduced its first consumer decks in late summer, with industrial models to follow. Other companies have licensed the technology, including Sharp, Hitachi, Mitsubishi, Toshiba, Matsushita, Panasonic, and Zenith. A wide selection of decks, camcorders, and editing systems modeled after what is now available for ¾-inch U-matic should be out soon.

New Life For Silicon

MATERIALS such as gallium arsenide, which lets manufacturers make computer chips that run faster and need less power, have received a great deal of attention in the last few years as replacements for silicon, the traditional stuff of semiconductors. However, researchers at IBM recently fabricated the world's smallest silicon transistor, demonstrating that silicon may long reign as the semiconductor material of choice.

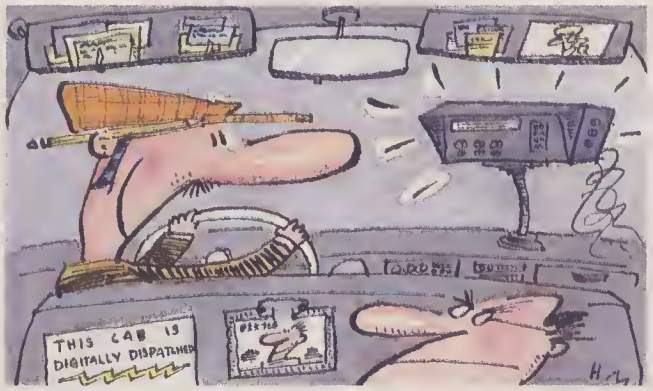
"We have shown that there is still life in silicon for some time to come," says Dr. George Sei-Halasz, manager of exploratory structures at IBM's research division in Yorktown Heights, N.Y.

Transistors are the building blocks of computer chips.

IBM says its experimental transistor is the first made entirely of elements that are only one tenth of a micron wide—about a thousand times thinner than a human hair. To maintain a clear, strong electronic signal at this size, the transistor was cooled with liquid nitrogen to –321 degrees Fahrenheit, greatly reducing electrical resistance.

IBM says the miniaturized elements are so small that millions of them could be packed onto a small chip. Such chips would power personal-computer-sized machines able to solve problems like weather forecasting that tax today's mainframes.

However, better fabrication techniques must be developed before chips using the miniature elements can enter commercial production, cautions Sei-Halasz.



HAL MAYFORTH

A Better Way To Hail A Cab

COMPUTERIZED, digital radio-dispatching systems are helping taxi companies chase fares more efficiently.

Mobile Data Systems International, Gandalf Technologies, and Motorola have developed products that offer fast and equitable distribution of calls to drivers.

Motorola in Schaumberg, Ill., is testing its KDT 440 system in Pompano Beach, Fla., and plans to install two more systems next year. Mobile Data Systems of Richmond, B.C., plans to install its Model 9031 in Houston and London, and Gandalf, based in Nepean, Ontario, has set up its Cabmate system in several cities. All three systems cost about $500,000 for a 200-cab fleet.

Motorola's system consists of a base unit at the dispatching center and liquid-crystal display terminals in each cab. Dispatchers enter calls into the system, which automatically contacts the closest available cab. If the driver accepts, the terminal displays the fare's address.

The technology is already making friends in the taxi business,. Mike Gaddis, president of Yellow Cab Co. in Fort Lauderdale, Fla., which uses the Motorola system in Pompano Beach, claims the system has cut response time by more than half. Says Gaddis, "The drivers who have been using it say they won't go back to voice dispatching."

WILLIAM MOLNAR

Touchscreens enliven presentations.

Adding Touch to Talks

A SLIDE or video marketing presentation may cost thousands of dollars but induce only yawns from jaded viewers. An Atlanta company, Still Current Design Inc., aims to enliven such presentations by combining touchscreen technology with laser-disk image storage.

The company's system, called Emedia, lets presenters arrange images and text in an outline format. Viewers use a touchscreen to choose areas they want to know more about, skipping quickly from one topic to another without having to flip through numerous slides or rewind a VCR.

Besides the touchscreen, the system includes an IBM PC/XT computer with a floppy-disk drive, a laser-disk drive that holds 2,000 images, and software.

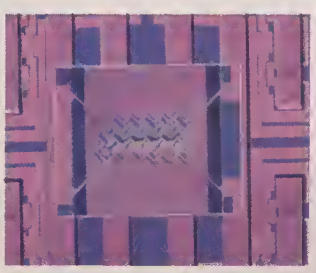
An $11,250 standard system runs presentations created by Still Current Design. Presenters who want to produce their own shows must buy an $5,000 upgrade, which adds a mouse, a keyboard, color-graphics software, a still-image video camera, and an optional printer.

An additional $3,500 adds stereo sound and the ability to store 30 minutes of moving images; this package also converts material from VHS cassettes to disk.

Sensing an Opportunity

SILICON microsensors are finding all sorts of new uses as costs fall. Companies working on ways to expand the $2-billion market for such sensors include three California firms: IC Sensors in Milpitas, NovaSensor in Fremont, and Sensym in Sunnyvale.

These companies build tiny silicon-based structures similar to microchips. The sensors use silicon technology to precisely measure mechanical changes. The microstructures are used for mass-flow control and to detect pressure, acceleration, or vibrati.



New uses for silicon sensors.

In the automotive sector, major automobile and tire manufacturers are testing silicon microsensors to create tire-pressure indicators. France's Michelin has announced work on a system for 1989 car models in Europe using Sensym sensors; American models could follow in 1990. Microsensors also have uses in advanced suspension systems, antiskid braking systems, exhaust-system monitoring, and airbags.

Other applications include medical equipment, robotics, and aerospace.

In addition to the small Silicon Valley companies developing microsensors, such larger companies as Motorola, Honeywell, GM, and several Japanese operations are reportedly working on the technology for their own internal use.

IC SENSORS

Medical Tests in the Bag

DOCTORS and veterinarians no longer need a laboratory for diagnostic tests. In some cases, tests can now be done inside a high-technology version of a plastic baggie.

PEM Tech Inc., a startup in East Palo Alto, Calif., has begun using plastic-envelope-method (PEM) technology to test for heartworms in dogs, as well as rapid blood clotting and sexually transmitted diseases—including AIDS and gonorrhea—in humans. PEM, which made its first appearance in hot-oil hair treatments, separates the test ingredients into different pouches in a bag. Squeezing the bag mixes the chemicals and begins the test. In addition to providing immediate results, the tests reduce handling of the test medium, an important safety factor.

Better plastic films and seals make the new technique possible, says Donald Warner, president of PEM Tech. Older seals were not always able to completely separate the parts of the test, he says. The company's products use Aklar plastic from Allied Corp.

According to Warner, the tests will find applications in third-world countries where laboratories are not available, in physicians' offices, and eventually in the home. PEM Tech hopes to turn its patented technology into a $5-million market in two years, Warner says, and that doesn't include the potentially explosive market for AIDS testing. PEM Tech claims to have already sold several thousand dog heartworm tests, and its tests for sexually transmitted diseases are now ready for market. Blood-clotting tests are undergoing final clinical trials, but the AIDS test is still several months away from completion. The AIDS test will not be sold to individuals.

STEVEN MARK NEEDHAM

Psion's computer thinks small.

Computer in Hand

COMPUTERS continue to come in smaller and smaller packages. Psion Ltd., a British company, has introduced the Organiser II, a nine-ounce computer about the size of a calculator—5.6×3×1.1 inches.

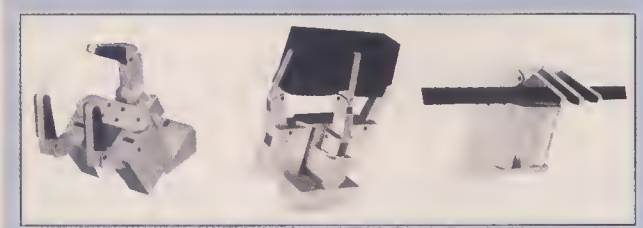
The company has already sold 60,000 of the $159.95 devices in the United States, plus 120,000 in Europe last year. But the computer's two-line liquid-crystal display and calculator-sized keyboard may limit its future.

Two thumb-sized slots in the back of the battery-operated machine accept solid-state memory units (the equivalent of floppy disks) called Datapacks. Software includes a spreadsheet compatible with Lotus' 1-2-3.

Psion officials say the Organiser's closest competition comes from programmable "super-calculators," including products from Hewlett-Packard and Fujitsu. Pete Lawson of Hewlett-Packard acknowledges the interest in computer-like features for calculators but says, "I don't think you'll see us miniaturize a personal computer."

Despite Psion's enthusiasm, some observers question the utility of any hand-held computer. Harvey Allison, an analyst at Wertheim & Co., says the lack of a full-sized keyboard and screen means the small size "isn't worth it."

ALSO WORTH NOTING



ODETICS INC.

Odetics says its robot hand can grip almost anything.

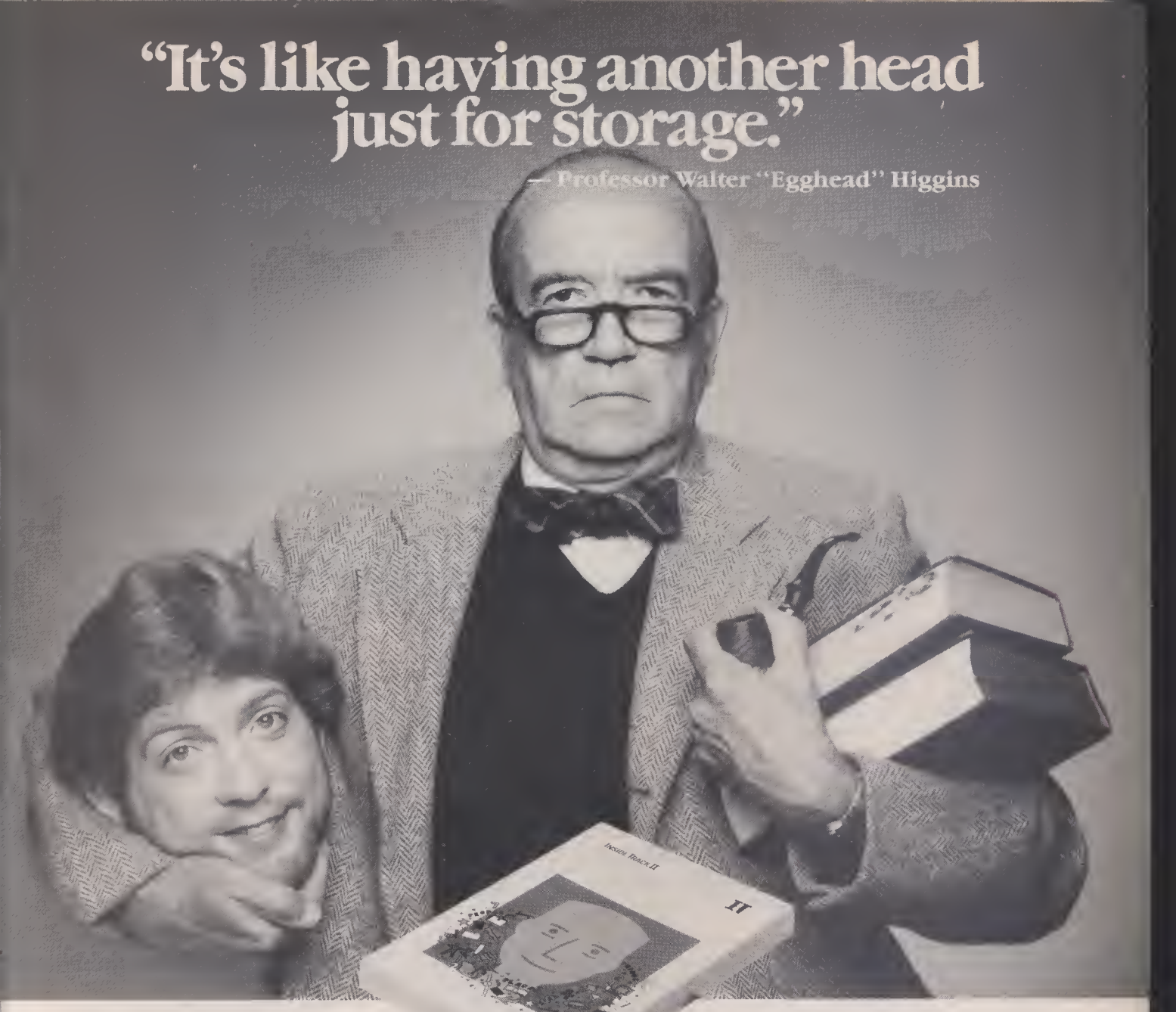
■ Robots extend their reach with a new self-contained "hand" under development at Odetics of Anaheim, Calif. The Odetics Hand has two "thumbs" and a "finger" that let it function as a vise, enveloper, scoop, or pliers. The company says the product can grip objects ranging from a pencil to a railroad tie. Applications include tool and materials handling, and assembly tasks in the defense, space, and nuclear-power industries. Odetics also wants the Hand to become part of a proposal to the Defense Dept. for an advanced robotic manipulator system.

■ Traditional lightning rods merely wait for lightning to strike. But a new lightning rod from France's Indelec electrically reaches out and grabs the lightning bolt, conducting it safely to earth. The Prevectron senses tracers, weak electrical impulses that precede a lightning bolt. When tracers come close to the rod, an electronic device generates ions that form an electrical path for the lightning to follow to the Prevectron, which safely grounds the tremendous currents. Indelec claims its product is more efficient than passive lightning rods, yet is neither more expensive nor more difficult to install. The company is now seeking U.S. distributors.

■ Let the chip-company takeovers begin. Edelson Technology Partners, a venture-capital firm in Saddlebrook, N.J., has bought more than 50 percent of California Devices' voting stock. HIGH TECHNOLOGY BUSINESS selected California Devices as one of the five most likely takeover targets in the industry (Sept. 1987). The chipmaker, based in Milpitas, filed for Chapter 11 protection from creditors in August, and Edelson's purchase was a key to the ensuing reorganization. According to partner Anthony Buffa, Edelson's goal is to "achieve profitability, increase production, and reduce expenses through selective personnel reduction."

"It's like having another head just for storage."

— Professor Walter "Egghead" Higgins



The professor is one of those people who collects facts the way Imelda Marcos collects shoes. No matter what you ask him, he always seems to have the answer on the tip of his tongue.

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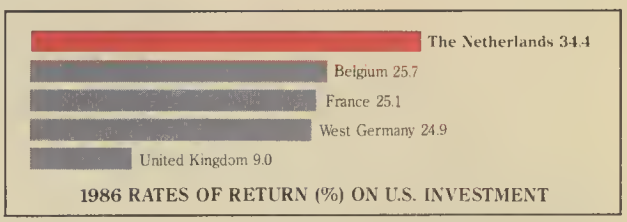

The average rate of return on U.S. direct investment in the Netherlands has been higher than the European norm throughout the 1980s.

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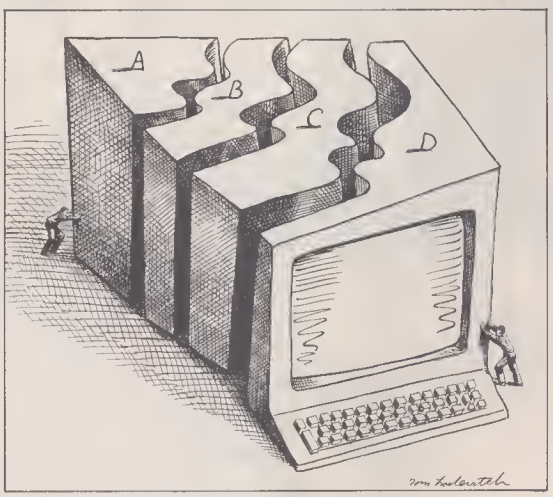
EASIER DATA TRANSFER ALTERS PURCHASES

■ **By Andrew M. Seybold**

ONLY A DECADE ago, it was relatively easy to choose the "right" desktop computer. Users didn't have to worry much about whether they could share resources, software applications, or data with everyone else in the office or company. Their primary objective was to find the personal computer, peripherals, and software that would fulfill their individual requirements. As a result, people could make decisions based on personal preference and price.

But as more and more desktop computers make their way into offices, companies must increasingly consider how to integrate these computers into cohesive, office-wide systems. It's not hard to understand why. These days, the number of different machines, different operating systems, and different types of software available is staggering. At the same time, the ability to connect with the systems of other people in the office—to share data and interact in a variety of ways—has become a necessity in today's business environments.



TOM LULEVITCH

Consequently, it's become vitally important that individuals not buy in a vacuum. Although personal preference and price must certainly be taken into account, a company's global requirements must also be considered. This applies as much to a company's second computer as to its 2,000th.

Many corporations cope by imposing hardware or software standards on personal-computer users, demanding that each purchase request adhere to certain guidelines. The goal is to maintain as much system compatibility as possible within the office.

Recent developments have made the situation even more complex. IBM and Apple have unveiled their next generation of computers, and other companies, including Compaq, have taken over the older IBM standard. Businesses now have more choices than ever—and more confusion concerning the best approach to retaining compatibility between systems.

Most corporate planners seem to overlook one factor in any computer-purchase decision. The introduction of these next-generation computers, the increased interest in networking these machines, and a new generation of computer software may invalidate decisions based strictly on hardware.

It's time to step back and evaluate the goal of computer standardization. Does it still make sense? Not really, given how easily data can be transferred now. Instead, planners ought to focus on enabling any number of people to use data, no matter where it resides, who generated it, or what format it's in.

The next-generation computers are ushering in a time when it's no longer relevant whether data was generated on an IBM PC/AT using a Lotus 1-2-3 spreadsheet, on a Macintosh using Microsoft's Excel, or on a mainframe and its various programs. As long as data can be shared, what does it matter whether it was born on an Apple II, an IBM Personal System/2, or a Compaq? What matters is the ability to move that data from one desktop to another (with some reasonable caution about who controls it), and also its availability, once transported, to users in a form they can use on their own systems.

Much is happening in the computer world to weaken hardware standards and shift the emphasis to data transfer. For example, many software companies have released versions of their programs that work with all three hardware standards—the new IBM Personal System/2, the older IBM PC and PC/AT systems, and the Macintosh. Most of these programs also include coding that lets people transfer files from one type of system to another.

Add to this the ability to move files from one operating system to another through electronic mail, local-area networks, and file-conversion facilities (such as those offered by Dayna Communications with its PC to Mac and Back hardware/software combination), and it becomes obvious that, within only a few months, the hardware used to generate data may not be nearly as important as the data it generates and how that data is used.

In light of these developments, the strategy for business computer users and others concerned about office-automation requirements is simple: Elevate requirements from hardware standardization to data-transfer standardization. Not only will this permit a broader choice of computer systems within a company, but it will also free users to choose the systems and software they prefer. The ultimate result will be more productive, more proficient use of these powerful business tools. ■

Andrew M. Seybold is editor-in-chief of Andrew Seybold's Outlook on Professional Computing, *a California-based newsletter.*

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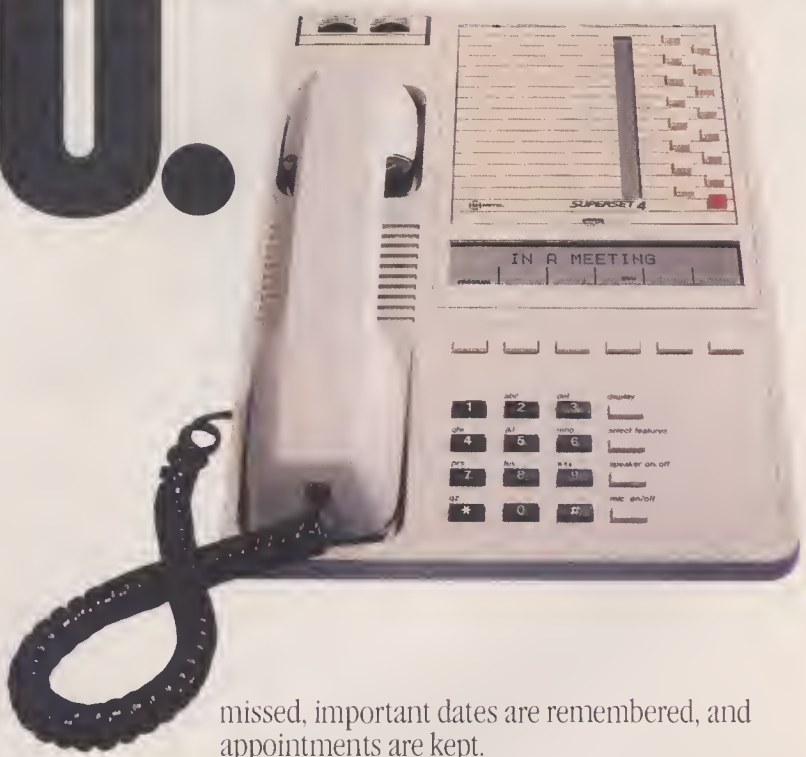

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The Language Advantage

JAPAN'S MACHINE TRANSLATORS RULE THE MARKET

By Robert Chapman Wood

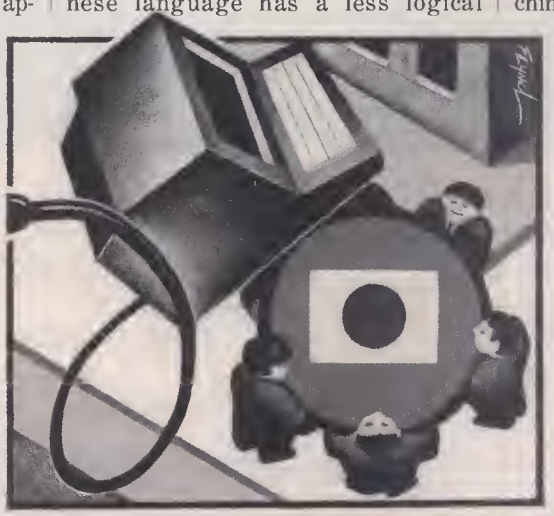
TODAY, MORE THAN 20 years after computerized language translation was laughed out of the funding process in the United States, several Japanese companies and industry/government collaborations are beginning to turn the once-derided technology into a gold mine of new applications and opportunities. The top U.S. company estimates that the annual market for international translation is at least $10 billion, and as machine translation systems improve they will command an increasing share of a market growing at a rate of 10 to 15 percent a year.

Fujitsu, the leader in the field, introduced its commercial English-to-Japanese and Japanese-to-English translation systems in 1984. The company reports that it has already sold more than 130 of its mainframe-based Atlas systems in Japan. Hitachi, in second place in Japan, has sold 19 of its mainframe systems. Other major Japanese players include Bravice, Mitsubishi Electric, and Sharp.

Logos, the U.S. leader in machine translation, has sold only 31 systems. Others in the market include Automated Language Processing Systems, TII, and Worldwide Communications, but the U.S. players don't make Japanese systems.

Although the full commercial impact of machine translation still seems a few years away, it's clear that automatic translation will probably let the Japanese do an even better job of harvesting the technology of the West. Japanese companies are already using computer systems to translate such materials as technological articles, news reports, and product documentation and specifications. Nihon Keizai Shimbun, the world's largest on-line business-news service, uses automatic systems to translate currency-transaction headlines from Western news sources.

It's less clear whether automatic language translation will help American companies follow Japanese technology, because translating Japanese into English is much more difficult than translating English into Japanese. The Japanese language has a less logical structure than that of European languages, and an enormous share of Japanese sentences do not specify their subjects. According to Fujitsu, manual "pre-editing" is often necessary before the automated translation systems can do their work.



FRED LYNCH

The Japanese haven't given up, however, and Japan's Ministry of International Trade and Industry's Electro-Technical Laboratory recently completed a project to improve machine translations from Japanese to English. First reports indicate the system could represent a significant improvement in translation capability. One possible use for the new technology will be to help the Japan Information Center for Science and Technology (JICST) make its information available in English. JICST maintains probably the world's largest databases of scientific and technical information, covering the entire world, not just Japan.

Machine translation is still far from perfect, especially when dealing with idiomatic language. But experts say it's already useful for work in specialized domains, in which idioms are rare and the machine can be taught the appropriate technical vocabulary. Some machine-translation specialists argue that even the much-maligned computerized translations of the 1960s—which reportedly translated "The spirit is willing but the flesh is weak" into Russian and back to English as "The vodka is strong but the meat is rotten"—weren't that bad in limited domains. Those early efforts often contained errors, but nevertheless were usually comprehensible.

The real problem holding back automatic language translation was never really accuracy, but economics. In the 1960s, it hardly made sense to devote a $3-million mainframe computer to producing relatively poor translations when a $10,000-a-year human translator could deliver good ones.

In the 1970s, new technology dramatically changed the economics of machine translation, but only the Japanese seemed to notice. They believed that cheaper computers and better programming would make machine translation economically useful. This is now starting to happen.

Meanwhile, new developments in artificial intelligence hold the promise of truly human-like translations farther down the road. The Japanese are already exploring that possibility with their widely publicized Fifth Generation Project, designed to develop a new order of supercomputers. ■

Robert Chapman Wood is a writer and business consultant who has specialized in the Orient for more than 12 years.

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Data Access Cost May Rise

PENDING FEE RULING AFFECTS ON-LINE SERVICES

■ **By William A. Tanenbaum**

ANYONE WHO USES electronic mail or does research through an outside database—in fact, anyone who transmits any kind of computerized data over telephone lines—should watch closely the decision on a rule proposed by the Federal Communications Commission. The proposal, which would increase the cost of using on-line computer and information services, could affect virtually every computer user in the United States.

The FCC rule would require companies that provide so-called enhanced services to pay a fee to connect them to the local telephone network, much as AT&T, MCI, and other long-distance carriers now pay local telephone companies for connections to local telephone exchanges. All or part of these connection fees probably would be passed on to subscribers to the services.

MARK KSENIAK

Enhanced-service providers include companies such as Telenet, Tymnet, and other data networks. Such "packet-switch" networks ship packets of information via phone lines to a host computer, which processes the information and returns it. Other enhanced-service providers include information services such as The Source, Dow Jones, Lexis, and Nexis, which use the packet-switch networks to connect their central processing computers with subscribers' equipment. The myriad electronic-mail services, bulletin boards, databases, and other information-retrieval services that use telephone lines also are considered enhanced-service providers.

Industry observers believe the access fee would increase the cost of an on-line connection to these services by $4 to $6 per hour. Although some subscribers could absorb this cost, in many cases it would significantly increase the expense of such services and would virtually double the current off-peak charge of $5 per hour for services such as GEnie. Such a sharp rise could seriously affect customers' willingness to sign up for an on-line service or continue using one. Indeed, smaller services contend that such customer reluctance could be substantial enough to prevent such services from being commercially viable.

If the rule is adopted, providers of enhanced services can be expected to change their operations to minimize access charges. Many enhanced services currently use a single host computer to process data from across the country; some may decentralize and do more processing at their customers' sites, or at "node" computers set up in regional centers. Such a move would reduce access charges, which will depend on both the number and length of telephone transmissions.

Enhanced-service providers also could bypass local telephone exchanges by using dedicated or leased telephone lines linked directly to subscribers or to large office buildings and office parks. In another tactic, the service companies could connect distributed computer nodes to subscribers and to the provider's central computer. Private data networks that use microwave, fiber-optic, cable, and satellite transmission also would bypass local exchanges and thus access charges.

A subscriber also could use enhanced services that do not cross state lines, and thus would not be subject to the proposed fee. Localized databases are one candidate for this type of service. However, both subscribers and providers should take into account whether the savings from such strategies will warrant leaving the telephone network.

A business that does not use such networks enough to justify the cost of a dedicated telephone line or a private data network has few ways to avoid access fees passed on by the service providers. However, these increased costs may be offset by lower local telephone bills. Telephone connection time should be reduced, and managers should be sure that telephone company charges for local message units are correspondingly decreased. Managers should also be sure that their companies receive improved transmission quality and automated record keeping. In addition, managers should make sure that an enhanced-service provider is not imposing part of the interstate access fee on a use that involves transmission only within state boundaries.

A decision is due by the first quarter of next year on whether it will cost more to reach out and touch computerized data. There is strong opposition to the proposed enhanced-service access fee, but if it is adopted by the FCC, it will result in hidden advantages as well as increased costs. Strategic planning can maximize the first and minimize the second. ■

William A. Tanenbaum practices law with Phillips, Nizer, Benjamin, Krim & Ballon in New York City.

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Workstation Wars: The Battle Of the Big 7

The duel for a $2-billion market is about to become a brawl as the giants muscle in

By Michael R. Leibowitz

In March, Apple introduced its Macintosh II, a personal computer with the power to challenge low-end workstations. In April, IBM followed suit with the debut of its PS/2 Model 80. In June, Digital Equipment dropped the price of its VAXstation 2000 workstation to $4,600, then the lowest in the industry.

These three examples are only a few of the attempts by major computer makers to grab part of the exploding market for technical workstations. But even as the big guns take on market leaders Sun Microsystems and Apollo Computer in the workstation market, the two newer companies are breaking out of the niche they began building in the early 1980s.

Workstations, sophisticated computers that display startling graphics and are tightly tied together in powerful networks, got their start in the world's engineering labs. But Sun and Apollo, which will rack up more than $500 million each in workstation sales this year, are looking to move the $2-billion market into a broader spectrum of computer applications.

The spectacular success of the workstation market so far has attracted the attention of such powerhouses as IBM, Digital Equipment, Hewlett-Packard, Apple, the Japanese, and virtually everyone else in the computer business.

The conflict was inevitable. The very concept of workstations, in which computing power is distributed among users, challenges the traditional shared-processing approach of mainframe and minicomputers. As workstations increase in power and complexity, they are bumping up against the preserves of the minicomputer and mainframe companies. And the new breed of more powerful personal computers threatens

THE BIG 7

Sun
Apollo
Hewlett-Packard
Digital Equipment
IBM
Apple
NEC

Though not the largest, these companies have the brightest future in workstations.

DEVIS GREBU

the low end of the workstation market.

As Sun and Apollo continue to battle each other, the big computer companies will bring their tremendous resources to bear, including broad product lines; massive sales, service, and support capabilities; and most important, hardware and software compatibility with their huge installed bases. But the behemoths have to be careful; too hard a push into the workstation market could cannibalize their existing product lines.

The workstation market has come a long way from the one-product, one-market business that Apollo created when it shipped the first workstation in 1981. The company took the latest microprocessor technology from chipmakers and built high-performance, low-cost computers for the engineering desk. The machines displayed high-resolution images, a key to performing early workstation tasks such as circuit design and semiconductor-chip layout. Just as important, workstations could be tied into a network so one engineer can easily share data with others.

Engineers quickly embraced workstations for designing everything from integrated circuits to mechanical components. Today, the market for workstations has broadened to include products priced from $5,000 to $120,000. A wealth of applications software and products have unearthed a wide variety of new uses. General Motors uses work-

WHAT IS A WORKSTATION?

A workstation is a powerful, 32-bit computer that fits on a desk, but differs from personal computers in its greater power and sharper graphics. At the moment, workstations fall somewhere between personal computers and the larger minicomputer or mainframe systems, although the distinction between these systems is becoming increasingly blurry.

An Apollo Series 4000 workstation.

Many low-end workstations provide more power than a Digital Equipment VAX 11/780 minicomputer, which until a few years ago was an engineering and scientific standard. Also, each workstation is devoted to one person at a time, whereas the old VAX parceled its resources among 20. This extra computing and graphics power lets workstations handle complex tasks that are impractical on a personal computer, or that would be one of many demands on a mainframe or minicomputer system.

An IBM PC/XT personal computer.

Workstations differ from conventional computer systems in providing each user with a guaranteed amount of processing power at all times. Conventional time-share computing systems can slow each user's processing to a crawl if many users compete for resources at once.

Workstations reveal their true power when linked into networks through two kinds of machines called "servers." One such machine, the file server, stores and retrieves data files for the workstations; it acts as the central data-storage depot for the network.

A workstation user who needs additional computing resources to run a specialized or time-consuming task can direct it to the compute server, which may come from the workstation manufacturer or another company. The compute server runs the task when it has the time. Meanwhile, the user can do other tasks on the workstation.

"The user becomes a pilot in the cockpit," says Brad Smith, a research director at Dataquest Inc. "He flies his application around to the different computers in the network."

A workstation also differs from shared minicomputers or mainframes in graphics capability. Workstations cram all types of pictures, symbols, and text from more than one application into individual "windows" on an oversized, high-resolution screen.

But the price/performance ratio may be one of the biggest differences between workstations and shared processing systems. Workstations first became practical with the emergence of powerful 32-bit microprocessors in the early 1980s. Because workstations are actually relatively small, modular computing elements, they use common, low-cost microprocessors and other circuitry. Mainframe and minicomputers, which operate much faster to serve all their users at once, must use exotic and far more expensive semiconductor technology and cooling schemes.

On the low end, the distinction between personal computers and workstations has begun to fade as Apple, IBM, Compaq, and others have introduced models that rival low-end workstations in power and graphics capability. The boundary will continue to erode to the point where, someday, most desktop computers will have enough power—including graphics and networking capabilities—to be called workstations. When that day comes, only the simplest of desktop computers will be called "personal computers." ■

stations for styling automobiles—Kraft uses them to design ketchup bottles. Other companies have applied workstations to such tasks as developing software and producing technical documentation. As Apollo, Sun, and other industry upstarts drive down costs and raise performance, new applications keep surfacing.

Brad Smith, a research director with market analyst Dataquest, has identified 12 market segments that use workstations, embracing applications from geophysical mapping of oil and gas deposits to flight simulation. Although electrical and mechanical design automation still heads the list, accounting for 38 percent of 1987 workstation revenues, software development follows with 25 percent of the market. In third place, computer-aided publishing holds a nine-percent market share.

One of the latest workstation applications involves automation for stock traders. One workstation can replace the five or more terminals that typically clutter a trader's desk. Information formerly displayed on separate terminals—quotations, market statistics, technical analysis, financial data—appears in "windows," rectangular areas on the workstation's high-resolution screen. Charts and graphs present data symbolically, and a central window displays the results of an artificial-intelligence program that combines data from several sources to advise the trader whether to buy, sell, or hold a particular stock.

Some analysts predict that the vast majority of future workstation applications lie in the commercial sector. Vicki Brown, an analyst with International Data Corp., forecasts that by 1991, 85 percent of workstation revenues will come from the commercial sector—an area that currently represents less than five percent of workstation sales.

"Look at any technology in the computer industry," says Brown. "It has always started in the technical realm. It takes a couple of years for the tekkies to prove that it works."

Despite Brown's enthusiasm, even the workstation companies themselves

seem to feel it's too early to count on the commercial market taking over. "I see such an explosion in so many different marketplaces," reasons Roland Pampel, president of Apollo. Scott McNealy, Sun's president, admits, "I'm not sure what the workstation market is."

The remarkable fact about the demand for workstations is that its phenomenal growth does not depend on expansion beyond the traditional base of scientists, engineers, and programmers. According to Dataquest's Smith, that market alone includes eight million workers worldwide. He estimates that about four million of them already have personal computers on their desks, and eventually 2.5 million of those personal computers will be replaced by engineering workstations. So far, the industry has shipped only 163,000 workstations.

That's why most observers believe the workstation industry has a bright future no matter what happens in the commercial market. Dataquest projects that industry-wide revenues will grow an average of 30 percent annually through 1991, when revenues will hit $6.3 billion.

So far, the two largest beneficiaries of the market's blockbuster growth have been Sun and Apollo. Sun, founded a year after Apollo and likely to surpass its elder competitor in sales this year, has achieved a reputation as the maverick leader of the workstation market. The company has repeatedly flouted the time-honored rules of the computer business, redefining accepted practice and sending its competitors scurrying to follow its lead.

For example, Sun got the industry to support standards—a radical departure from the tradition of using proprietary technology to lock customers into one company's equipment. In its earliest systems, Sun supported standards such as the Unix operating system, which lets customers tap into a rapidly growing base of software under development by independent makers. Due to the company's promotion of this concept, workstation customers now demand that their systems be "open," using industry standards to work with products from other manufacturers.

Other workstation companies, including Apollo, Digital, and Hewlett-Packard, eventually had to give in and support standards as well.

Pricing innovation is another Sun strategy. Typically the aggressor in price/performance skirmishes, Sun has confounded the experts who said companies should charge what the market will bear. Last spring, Sun shocked its competitors by dropping the list price of its hottest selling workstation from $7,990 to $4,995.

"Clearly, the market would bear a higher price," says Sun's McNealy. "But we think there's an elasticity of greater than one in the marketplace"—meaning he's confident that Sun's sales will increase more than enough to cover the price cuts. Sun's action triggered a flurry of price drops from competitors Apollo, Digital, and Hewlett-Packard.

Sun has also rewritten the laws that define how quickly a workstation company can belt out new products—or how fast it can grow. Sun stunned the market with closely spaced introductions of products at both the high and low end of the performance spectrum.

Sun closed fiscal 1987 with sales of $538 million, roughly two and a half times its 1986 sales of $210 million. Analysts expect the company's revenue to

7 Sun

PRODUCTS Low-end, midrange, and high-end workstations and servers.

STRENGTHS Market leader; broad product range; reputation for superior price/performance ratio and "open" workstations (compatible with various types of software).

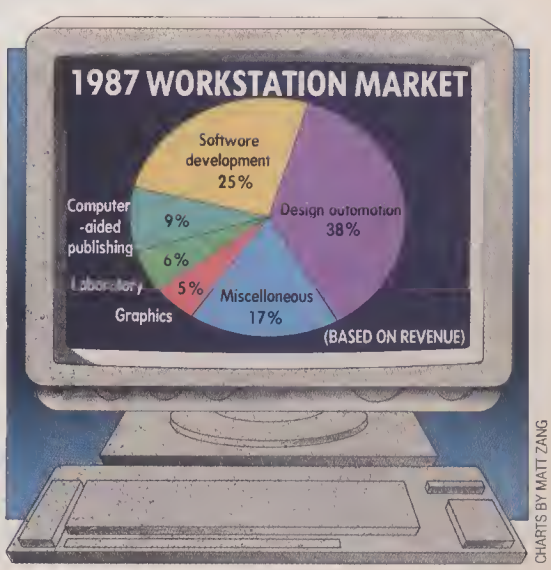
CHALLENGES Maintain superior price/performance ratio; manage rapid growth; beef up sales, marketing, and distribution.

STRATEGY Broaden product line and maintain price/performance leadership.

■ **Scott McNealy, president.**

GEORGE STEINMETZ

Sun Microsystems
2550 Garcia Ave.
Mountain View, CA 94043
(415) 960-1300



CHARTS BY MATT ZANG

7 Apollo

PRODUCTS Low-end, midrange, and high-end workstations and servers.

STRENGTHS Reputation for superior networking and graphics.

CHALLENGES Keep up with archrival Sun in price/performance; broaden application base.

STRATEGY Concentrate on less price-sensitive, feature-oriented applications.

BILL O'CONNELL

■ **Roland Pampel, president.**

Apollo Computer
330 Billerica Rd.
Chelmsford, MA 01824
(617) 256-6600

grow to $800 million in 1988. Profits have also grown, to $36.3 million in fiscal 1987, tripling the 1986 figure of $12 million. The company has turned a profit every year after its 1982 startup.

McNealy, Sun's 32-year-old cofounder, says he would grow the company even faster if he did not have to show Wall Street a profit. Instead, he finds himself holding back. "That's the toughest thing," says McNealy. "When there's an open cookie jar, I just want to stick my hand in."

"That's Sun's mentality," acknowledges Robert Herwick, a senior analyst with Hambrecht & Quist. "They have a 'go for it' type of product strategy, whereas Apollo wants all four wheels on the ground."

Apollo, based in Chelmsford, Mass., has decided to take a far more conservative tack. "I'd like to consider ourselves good businessmen," says Apollo president Pampel. "If we're going to go into a market, I'd hope that we would know how we're going to support it."

Apollo experienced terrific growth and profitability until 1985, when a slump in the semiconductor and electronics industry hit the company like a sledgehammer. Apollo's top three customers, who accounted for a significant portion of sales, curtailed buying and Apollo found itself sitting on a brand new factory and a bloated inventory. Sun's success on the standards issue also hurt, as Sun's open systems began winning business from Apollo.

Apollo responded by swiftly converting its systems to support standards, including Unix, and expanding its application and customer base. After losing $14 million on sales of $296 million in 1985, the company posted a small profit on sales of $392 million in 1986. Apollo rebounded in 1987, reporting first-half sales of $236 million and profits of $14 million. Analysts project that Apollo will top $500 million in sales for 1987 and reach $650 million in sales in 1988.

Although comparisons between Apollo and Sun are inevitable, the companies approach the market in fundamentally different ways. Sun has traditionally pushed what the industry calls "hot boxes"—machines that feature an irresistible price/performance ratio. Sun is also vigorously expanding its product line into low-end, cost-sensitive workstation markets.

Apollo, though trying to remain competitive with Sun, directs its attention to higher-end markets and concentrates on offering extra functionality. Apollo machines offer better networking features, and are considered to have superior graphics.

"Apollo seems to be pursuing a strategy that involves building more defensible positions in vertical market segments," says Hambrecht & Quist's Herwick. These markets include software engineering and electrical and mechanical design automation. Together, these markets represented 80 percent of Apollo's 1985 revenue.

"It's a sound strategy," says Herwick. "Apollo will not grow as fast as Sun, but it will continue to be one of the faster growing computer companies."

Other players in the workstation market—including Silicon Graphics, Symbolics, Data General, Texas Instruments, Xerox, Masscomp, Prime Computer, and startups Stellar Computer and Dana Computer—may enjoy solid futures, but are not expected to pose major threats to the market leaders.

The workstation market will have to contend with increasing competition from the kingpins of the computer business, however. Digital, IBM, and Hewlett-Packard have all entered the workstation business within the last two years, and Apple's Macintosh II fea-

7 Hewlett-Packard

PRODUCTS Low-end, midrange, and high-end workstations and servers.

STRENGTHS Loyal customer base; excellent reputation for service and support.

CHALLENGES Maintain satisfactory price/performance ratio to prevent incursion on account base by Sun or Apollo.

STRATEGY Leverage loyalty of existing account base.

ED KASHI

■ **Bill Kay, general manager, Technical Systems.**

Hewlett-Packard
3404 E. Harmony Rd.
Fort Collins, CO 80525
(303) 229-3800

tures many workstation capabilities. Although many in the industry agree that the new entrants' initial offerings have trouble going head to head with Sun and Apollo, analysts say the competition is bound to heat up.

The big three had no choice but to introduce workstations. Sun and Apollo had been showing customers that the best way to distribute computing power is often to put a small computer on the user's desk. The industry was beginning to realize that a network of workstations can be less expensive and far more functional than the traditional method of sharing the resources of one large computer.

In a sense, the workstation concept takes the personal-computer revolution a step further, with higher performance, better graphics, and networking capabilities that mimic the abilities of larger computers.

But the transition to a new strategy will be difficult for the mainline computer companies, because most of their products are devoted to the old method of shared processing. A hot workstation line could easily cannibalize sales of their other, higher-margin, products.

Of the three, Hewlett-Packard has done the best job of addressing its customers' desire for workstations. In 1986 it sat behind Sun and Apollo in the number-three spot in the workstation market. Hewlett-Packard offers a good balance of products for its heavily engineering- and science-oriented customer base, and provides legendary service and support. "The trap the whole industry is in is to talk about MIPS [millions of instructions per second], vectors per second, things of that level," says Bill Kay, general manager of Hewlett-Packard's Technical Systems Business Unit. But because the industry does tend to dwell on specifications, and Hewlett-Packard tends to trail Sun and Apollo in price/performance ratio, analysts expect the company to sell mostly to its existing accounts.

Digital has the most to lose from an aggressive plunge into workstations. The performance of workstations tends to overlap that of the $9.3-billion company's tightly woven line of VAX mini- and superminicomputers. Also, VAX systems tend to find homes in the technical market—the very market that has been embracing workstations. Thus, high-performance, low-price workstations would compete directly with Digital's existing products. Perhaps worse, the demand for standards in the workstation market could corrupt the company's strategy of trying to create a totally "Digital" computer environment for its customers.

Not surprisingly, Digital is generally viewed as lagging the upstarts in price/performance and other features. Analyst Herwick says users "sneer about Digital. Digital is a joke in the exalted segments of the engineering/scientific-user community. Digital is basically not winning any new customers." Instead, Herwick says, the company has "an installed base that it is seeking to lock in and defend against all comers."

But Digital claims to be on the offensive. In September, the company introduced its VAXstation 3200 and 3500, which run 2.5 to 4.2 percent faster than its previous models. The new products, which start at $19,900, are expected to boost Digital's competitiveness. And last June, the company dropped the list price of its low-end VAXstation 2000 from $10,000 to $4,600. "We now have the lowest entry-price workstation in the marketplace," said Christopher Reed, Digital's marketing manager for workstations, shortly after the reduction.

List prices, however, are deceptive. In volume, Sun discounts its workstations 30 to 40 percent, whereas Digital

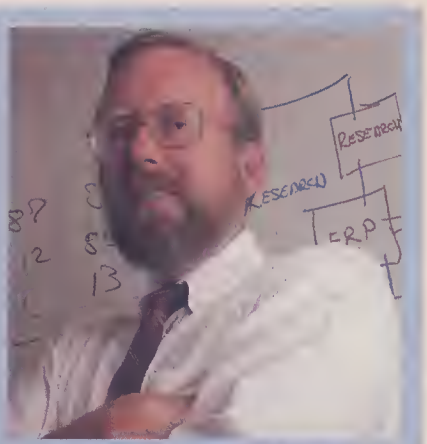
7 Digital

PRODUCTS Full range of workstations, servers, mini- and superminicomputers, and networking systems.

STRENGTHS Large customer base using proprietary VMS operating system; large sales and service organization.

CHALLENGES Improve price/performance ratio without cannibalizing minicomputer product line; change reputation for poor price/performance ratio and "closed" systems.

STRATEGY Introduce standards; improve price/performance; leverage installed base and breadth of product line.



BILL O'CONNELL

■ **Sam Fuller, v.p., research and architecture.**

Digital Equipment Corp.
146 Main St.
Maynard, MA 01754
(617) B97-5111

7 IBM

PRODUCTS Low-end and midrange workstations and servers, plus a broad range of personal computers, minicomputers, and mainframes.

STRENGTHS Large installed base in commercial sector; incredible might in sales, marketing, and manufacturing; low-end workstation, PS/2 Model 80, destined to become a standard.

CHALLENGES Fill major gap in product line; encourage development of software for PS/2.

STRATEGY No coherent strategy evident.

ALAN BOLESTA

■ **William Lowe, president, Entry Systems.**

IBM
Informatian Systems Group
900 King St.
Rye Brook, NY 10573

Apple

PRODUCTS Low-end workstation, the Macintosh II.

STRENGTHS Popularity of the original Macintosh; powerful manufacturing and marketing clout; broad distribution.

CHALLENGES Broaden its narrow product line; encourage software development; educate dealers inexperienced in selling technical systems.

STRATEGY Leverage popularity of the original Macintosh and broad distribution channels.

ED KASHI

■ **John Sculley, president and CEO.**

Apple Computer
20525 Morioni Ave.
Cupertino, CA 95014
(408) 973-2222

will not discount more than 20 to 25 percent. And even though Digital boasts of increasing support for standards, buyers say that the company pushes its proprietary VMS operating system and offers its version of Unix, which it calls Ultrix, only as a last resort.

Digital is expected to do increasingly well among its traditional minicomputer customers, who may be willing to sacrifice price/performance for software compatibility with their existing machines. That compatibility will also help the company penetrate the commercial market. Commercial customers tend to care more about a broad, compatible product line, and Digital boasts a line of products ranging from $4,600 to $4.5 million. Corporate accounts also perceive Digital as a safer bet than the new workstation companies.

Digital sees the commercial sector as a big opportunity. "This is not a new market for us," says Sam Fuller, Digital's vice president of research and architecture. The company has had considerable success in the commercial market with its other products, and has enjoyed early penetration into the financial market with its workstations.

As Digital and Hewlett-Packard push into the workstation market from the larger computer market and Apple attempts to move up from personal computers, IBM is eyeing the market from both sides. Along with Apple's introduction of the Macintosh II last March, IBM's April introduction of the PS/2 signified the emergence of a new front in the workstation war. These new personal computers offer good graphics, considerable processing power, and large memories. Judged as workstations, they are low-end machines, but their low cost prompted Sun to slash the price of its low-end workstation, triggering the industry-wide round of low-end price cuts.

IBM is clearly interested in the workstation market. However, the company's workstation strategy confuses many in the industry. The company has never been strong in engineering and science markets, and its first workstation entry, the RT-PC, introduced late in 1985, offered abysmal performance for the price. IBM has since improved the performance of the RT-PC and unveiled a powerful new personal computer—the PS/2 Model 80, based on Intel's 80386 32-bit microprocessor.

But experts say two problems continue to plague IBM's workstations. The PS/2 is still awaiting its OS/2 operating system, and the initial version, due in early 1988, will not make the system equal to competing workstations. An enhanced version of the operating system is not expected until 1989. Plus, IBM has a tremendous gap in its product line between the low-end PS/2 Model 80 and the high-end RT-PC.

IBM will ultimately fill the holes in its offerings. And, like the IBM PC, the PS/2 is destined to become a standard in the computer business. IBM's PC, introduced in 1981, became "The world's most successful personal computer," pointed out William C. Lowe, president of IBM's Entry System Division, at the PS/2's introduction. When the availability of workstation-type application software for the PS/2 challenges that of Sun and Apollo, analysts agree that IBM will become a significant force in workstations.

According to analysts, Apple has a chance to do well on the low end, but its lack of more sophisticated products will probably keep it from becoming a major force in high-end workstations. Many analysts feel that Apple's Macintosh II will be successful in workstation applications involving fewer than 10 users, including computer-aided publishing and software development.

NEC

PRODUCTS Midrange workstation and server; broad line of systems from PCs through mainframes.

STRENGTHS Manufacturing clout; broad computer product line; strong, stable organization.

CHALLENGES Broaden workstation product line; expand available software; penetrate workstation market.

STRATEGY Market products through resellers; expand 680X0 product line into low and high end; introduce workstations based on 80386 microprocessor.

■ **Frank Girard, vice president, systems sales.**

NEC Information Systems
1414 Mossochusetts Ave.
Boxborough, MA 01719
(617) 264-8000

"Apple has the opportunity to capture a significant market share," says IDC's Brown. The company's key advantages, according to Brown, are a broad distribution network and a large installed base of happy Apple owners who appreciate the friendliness of the original Macintosh.

"Just because engineers know how to use complex interfaces doesn't mean they want to," says John Sculley, Apple's president and CEO. "The intuitiveness of the Macintosh II, with its wide range of personal-productivity software, is our hidden weapon."

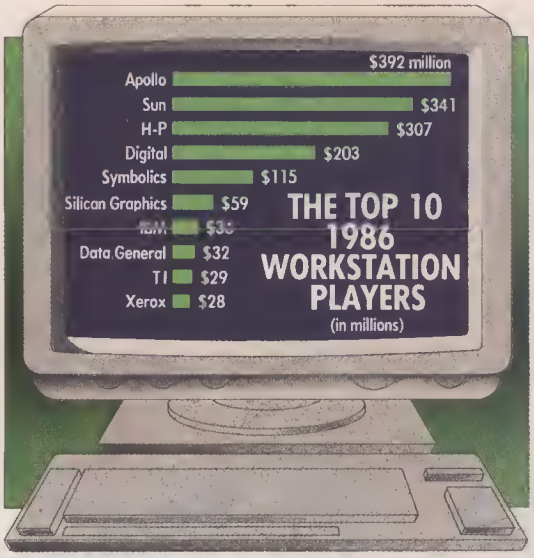
But few observers expect Apple to threaten Sun or Apollo in the heart of their business: demanding applications involving larger groups of users. Sophisticated applications often benefit from the features of high-level networking systems, and frequently require a range of workstation products. Not only does Apple lack high-end products and complex networking, but critics question its dealers' ability to sell into complex applications. Nor can Apple match its competitors in the availability of workstation software.

Until now, the workstation market has been largely addressed by domestic suppliers. However, its remarkable growth has attracted the interest of the Japanese. NEC has already introduced workstations in the United States, and Hitachi and Sony expect to export their workstations to the U.S. market. "There are going to be about 20 Japanese competitors," predicts Sun's McNealy.

But McNealy is not worried. Although some experts fear that the Japanese may buy their way into the U.S. workstation market as they have done in other markets, McNealy points out that workstations have a long way to go before they become commodities subject to pure price pressure. Part of the problem is that the life cycle of a workstation is currently 18 months, too short for Japanese tastes.

Other critics claim the Japanese are poorly equipped to provide the necessary level of service and support. Further, the high value of the yen has eliminated some of the Japanese cost advantage. According to Dataquest's Smith, 70 percent of the workstations sold in Japan come from Sun and Apollo.

But NEC, for example, "plans on playing in the workstation marketplace for the long haul," says Edward Wagner, NEC's U.S. workstation marketing director. Wagner says NEC plans to go after companies that package the system with application software and resell the machines, rather than selling directly to end users.



The company also may wield its manufacturing clout in high-end personal computers based on the 80386 processor to address the workstation market. "NEC is number three in personal computers in the world," says Frank Girard, NEC's vice president of systems sales and marketing. "We intend to have a 5 to 10 percent market share of the workstation business by 1990."

The flood of new competitors into the workstation market will bring new challenges for Sun and Apollo. Sun has seized on workstations as its entree into the big-time world of a broad computer systems supplier. Analysts say the company's biggest challenge will be to manage its precipitous growth and continue its record of flawlessly implementing product plans.

Some experts express concern over Sun's ability to maintain satisfactory margins as personal computers invade the low end of the market. Others point out that low-end products are merely Sun's foot in the door; the majority of the profit potential in the workstation business lies in such equipment as midrange and upper-end workstations and servers. The real problem, analysts say, is that the easy fruit has already been picked. Sun will have to sharpen its skills at vertical marketing in order to compete for the less technical business.

Apollo's challenge is to keep up with Sun in terms of value. Analysts say Apollo needs to continue to broaden its application mix beyond its traditional markets of design automation, and they worry about Apollo's decision to retreat from the low end. The company also needs to combat an image of offering less of an open system than Sun.

In the high end, both Apollo and Sun will increasingly clash with minicomputers and mainframes as they raise the performance of their workstations and networks. Ultimately, say experts, there will be three environments in computing: IBM's, Digital's, and those that support Unix. Sun and Apollo need to become savvy marketers and continue to push Unix and open systems.

Like other success stories in the computer industry's short history, Sun and Apollo found themselves in the right place at the right time, exploiting a window of lucrative opportunity. Both companies plan to continue to take advantage of the situation. Even conservative Apollo expects to be a $1-billion company by 1990. Aggressive Sun, meanwhile, refuses to state financial objectives. "Financial goals," McNealy says, "can only limit you." ■

Michael R. Leibowitz is a business writer specializing in the electronics industry.

OTHER WORKSTATION MAKERS

Data General
4400 Computer Dr.
Westboro, MA 01580
(617) 366-8911

Masscomp
1 Technology Park
Westford, MA 01886
(617) 692-6200

Prime Computer
Prime Park Way
Natick, MA 01760
(617) 655-8000

Silicon Graphics
2011 Stierlin Rd.
Mountain View, CA 94039
(415) 960-1980

Symbolics
11 Cambridge Center
Cambridge, MA 02142
(617) 621-7500

Texas Instruments
Box 2902
Austin, TX 78769
(512) 250-6278

Xerox Information Systems
Box 7018
Pasadena, CA 91109
(818) 351-2351

RECENT STARTUPS

Dana Computer
550 Del Rey Ave.
Sunnyvale, CA 94086
(408) 732-0400

Stellar Computer
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Newton, MA 02159
(617) 964-1000

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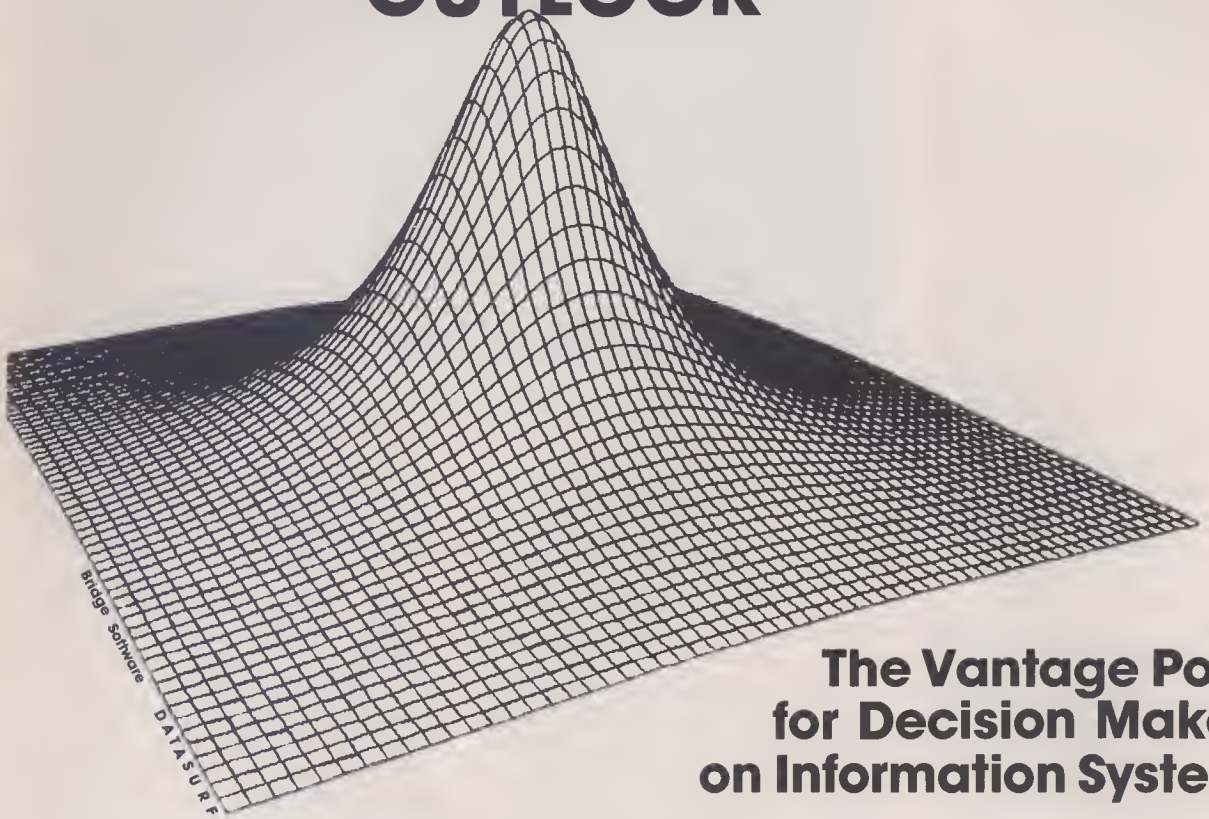

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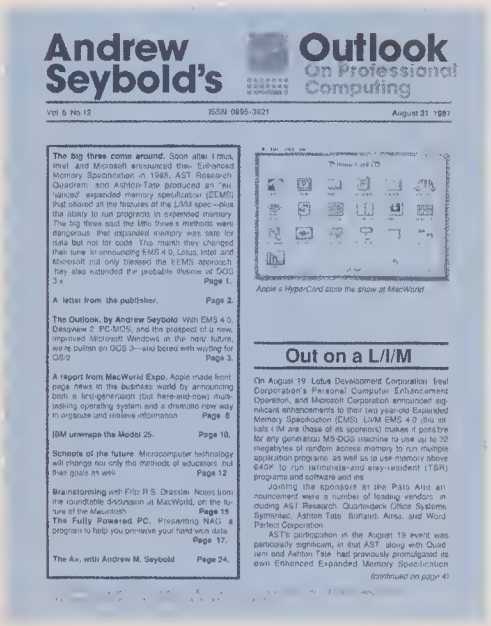

Andrew Seybold's Outlook On Professional Computing

Vol 6 No 12 ISSN 0895-2021 August 31 1987

The big three come around. Soon after Lotus, Intel and Microsoft announced their 'Enhanced Memory Specification' in 1985, AST Research Quadram and Ashton-Tate produced an 'enhanced' expanded memory specification (EEMS) that allowed all the features of the LIM spec—plus the ability to run programs in expanded memory. The big three said the little three's methods were dangerous that expanded memory was safe for data but not for code. This month they changed their tune in announcing EMS 4.0. Lotus, Intel and Microsoft not only blessed the EEMS approach they also extended the probable lifetime of DOS 3.x Page 1.

A letter from the publisher. Page 2.

The Outlook, by Andrew Seybold With EMS 4.0, Desqview 2, PC-MOS, and the prospect of a new, improved Microsoft Windows in the near future, we're bullish on DOS 3—and bored with waiting for OS/2 Page 3.

A report from MacWorld Expo. Apple made front page news in the business world by announcing both a first-generation (but here-and-now) multitasking operating system and a dramatic new way to organize and retrieve information Page 6

IBM unwraps the Model 25. Page 10.

Secrets of the future. Microcomputer technology will change not only the methods of educators but their goals as well Page 12

Brainstorming with Fritz R.S. Drasler. Notes from the roundtable discussion at MacWorld, on the future of the Macintosh Page 15

The Fully Powered PC. Presenting NAG, a program to help you retrieve your hard-won data Page 17.

The Ax, with Andrew M. Seybold Page 24.

Apple's HyperCard stole the show at MacWorld.

Out on a L/I/M

On August 19 Lotus Development Corporation (Intel Corporation's Personal Computer Enhancement Operation, and Microsoft Corporation announced significant enhancements to their two-year-old Expanded Memory Specification (EMS). LIM EMS 4.0 (the initials LIM are those of its sponsors) makes it possible for any generation MS-DOS machine to use up to 32 megabytes of random access memory to run multiple application programs as well as to use memory above 640K to run terminate-and-stay-resident (TSR) programs and software add ins

Joining the sponsors at the Palo Alto announcement were a number of leading vendors including AST Research, Quadram, Office Systems, Symmetric, Ashton Tate, Borland, Ansa, and Word Perfect Corporation

AST's participation in the August 19 event was particularly significant, in that AST, along with Quadram and Ashton Tate had previously promulgated its own Enhanced Expanded Memory Specification

(continued on page 4)

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Companies Cash In On Soviet Technology

Developments behind the Iron Curtain promise new markets; here's how some companies are benefiting

BY H. GARRETT DEYOUNG

JAMES ENDICOTT

IT STARTED AS one of those chance conversations that enliven any technical meeting. During a 1985 conference in Prague, a Czechoslovakian researcher was introduced to Brian Clark, a board member of Senetek, a technology-development company based in Mountain View, Calif. The Czech researcher had access to a water-absorbing plastic that had already made a killing as a soft-contact-lens material. The American had another use in mind—could the plastic be used by chemical processors to separate mixtures? They talked it over.

Two years later, a joint-venture company called Tessek was established in Prague to distribute the specially packaged plastic to biotechnology companies in the United States and elsewhere. The first East-West biotechnology venture was born.

A growing number of companies are finding that technology from Soviet-bloc countries can lead to new business opportunities with potentially big payoffs. Such agreements are becoming more common—partly because, for the first time, Soviet-bloc licensing agencies are aggressively promoting their technologies to Western buyers. Soviet premier Mikhail Gorbachev is striving to make industry more competitive with the West, largely through technology exchanges and East-West joint ventures, and there is a new eagerness to

trade. Also, Eastern Europe hopes to use such sales and licensing agreements to help relieve its chronic shortage of hard currency.

Consider these recent deals by companies that are profiting from the new environment:

- Senetek's joint venture with the Czech biotech firm VHJ Tesla, formed early this year, is expected to secure a prize niche in a $100-million annual market for separating and purifying proteins and other biological products. It will offer specialty products for analytical and research labs, and for testing in new process plants.
- Diversified Tech of Salt Lake City recently acquired rights to a Soviet plastic used in bone operations, opening the door to a $1.6-billion annual market in the United States and Europe.
- Plasmafusion, based in Grosse Ile, Mich., has licensed a Czech process for creating a high-temperature plasma and now has 34 joint ventures with steel, chemical, and food-processing companies to use the process.

All these companies would like to duplicate the success of one of the earliest such deals, which launched the $700-million soft-contact-lens industry. In 1965, National Patent Development Corp. (NPDC) of New York bought the rights to a water-absorbing plastic with the tongue-twisting name hydroxyethylmethylacrylate (HEMA), developed by chemist Otto Wichterle at the Czechoslovakian Academy of Sciences. In 1979, NPDC formed a subsidiary, American Hydron (which recently was sold and is now International Hydron). The subsidiary licensed the technology to Bausch & Lomb in return for half of that company's domestic soft-lens profits. The payoff was substantial; Bausch & Lomb now owns 70 percent of the market, and later licensees have included Johnson & Johnson, Warner-Lambert, and Ciba-Geigy.

"Virtually every soft contact lens is based on the Czech polymer," says Martin M. Pollak, president of International Hydron, which expects sales of $85 million in 1987. Like Brian Clark, Pollak heard of the material through a casual conversation, then dashed off to Prague to get details from the Czech licensing agency Polytechna.

So far, companies involved in metallurgy, materials such as plastics, and medical technology have benefited most from penetrating the Iron Curtain, where interest in materials technology is an outgrowth of military and strategic research. "They had mine sweepers with polymer hulls when the United States was still using wooden ones," says John Kiser, president of Kiser Research in Sperryville, Va., which specializes in setting up deals between American and foreign businesses. Soviet-bloc researchers are working on many of the technologies that are also high priorities among U.S. companies, including liquid-crystal and high-impact plastics, heat-resistant polyvinylchloride, electrically conductive materials, biocompatible drug-delivery materials, and membranes for separation and purification.

"By tradition, [Eastern-bloc countries] are highly oriented toward long-term research and development, and are very well grounded in physics, chemistry, and engineering," says Barney O'Meara, a Kiser associate.

One fundamental shortcoming of Eastern European development, however, is the inability to convert basic research into usable products and processes. "They tend to have a lot of problems getting their know-how from the lab to the shop floor, mostly because there are so many layers of authority," says William L. Frankhouser, a materials consultant in Bedford, Va. As a result, says O'Meara, only about 10 percent of new Soviet-bloc technology ever makes it to the marketplace.

That's where U.S. companies are beginning to enter the picture, by buying or licensing the basic technology and reengineering it into a commercial product or process. "They don't compete with us, so there's no economic disincentive to license to us," says Kiser. What's more, he says, Soviet-bloc expertise can often be had at low cost: "Their research-and-development costs are much lower, because their researchers usually earn only about a third [the salary] of their U.S. counterparts."

One of the greatest benefits of importing technology from Eastern-bloc countries is that the techniques or products often are unknown in the West. A company that gets an exclusive license has a sizeable jump on its competition. For example, potential competitors so far have been unable to duplicate the properties of HEMA, according to International Hydron's Pollak.

Senetek, through its joint venture Tessek, also has a license to sell HEMA, although it is not targeting the contact-lens market. Tessek will market the plastic as an agent for separating elements in chemical and biological mixtures; chemical laboratories around the world use $100 million worth of such mixtures each year.

This decision could have several payoffs for Senetek, says Melvin J. Ebeling, a Tessek vice president: "For one thing, it gives us a good position in a market we'd never get into otherwise. It also lets us market Eastern-bloc products in the West, and it could open the door for selling Western biotech products in COMECON (Council for Mutual Economic Assistance Countries) nations." Tessek will distribute its HEMA products first in England, Italy, and West Germany; negotiations are underway in Asia and South America.

Diversified Tech, which has licensed a plastic developed by Soviet scientists, could soon open up a surgical market of more than $1 billion a year, according to Frank Weinstock, the four-year-old company's chief financial officer. Weinstock says his company learned of the plastic during a routine review of Soviet technical reports, and licensed it in 1986. The Soviets were shaping the plastic into rods, to be surgically inserted into broken bones to aid healing. Unlike the customary steel and titanium pins, the plastic devices are easy to shape and seem to promote healing.

Despite these advantages, Diversified Tech's marketing plans have the bone-joining pins on the back burner. Instead, the company is targeting some

SURGICAL PLASTIC

DIVERSIFIED TECH
175 S. Main St.
Salt Lake City, UT 84111
(801) 364-5407

Founded
1980

1986 revenues
$58,462

Primary business
Medical technology

Company's market value
$38.8 million

Technology used
A plastic used mainly to connect or fill damaged bone tissue

Technology's origin
Soviet Union

Market
Hospitals and medical research facilities doing bone grafting, orthopedic surgery, cranial reconstruction, or spinal fusion; manufacturers of implantable drug-delivery devices

SOURCE: HIGH TECHNOLOGY BUSINESS RESEARCH

potentially more promising medical markets, including bone grafting, implantable drug-delivery devices, orthopedic surgery, cranial reconstruction, and spinal fusion. Rather than producing items for these uses, the company will provide the material to manufacturing licensees, which will then produce kits for distribution to hospitals and research facilities, at an average price of $200 per kit.

Diversified Tech will reap a five-percent royalty from the distributors' gross sales. Weinstock estimates that as many as 800,000 bone operations are performed in the United States and Europe every year, creating a target worldwide market of $1.6 billion. The company estimates the plastic could ultimately bring in as much as $80 million a year in royalties.

But not all Eastern European technology comes with ready-made markets. Plasmafusion, for example, is still exploring how to use a process for creating a high-temperature plasma. "We bought the process, then had to figure out what to do with it," says Plasmafusion president Jorge A. Morando. So far, it seems the risk is paying off. Plasmafusion, created in 1984 specifically to commercialize the Czech process, is now engaged in 34 joint ventures with steel, chemical, and food-processing companies that are investigating the process.

The technology uses graphite and water to generate a plasma—a very high-temperature cloud of charged particles. Morando says that using water rather than a gas (the conventional method) allows the plasma to reach much higher temperatures. Because the water also removes heat from the plasma-generating device, certain replaceable parts can be made out of $2.50 worth of common metal, rather than the $2,500 tungsten-carbide parts required by other plasma processes.

The intense flame created by the process can be used to destroy toxic wastes without forming unwanted by-products, produce ceramic shapes and coatings, and recover steel-mill by-products. Plasmafusion's strategy is to market the process to companies that can take advantage of these capabilities. Some of the applications being considered include an inexpensive technique for creating solid ceramic pipes and other shapes, and separation of methane gas into pure carbon for inks and coatings. In the steel industry, furnace components treated with the plasma last five to ten times longer than untreated tools, and tests show that the Plasmafusion process might recover waste iron from the half-million tons of furnace dust generated every year, which now costs $100 a ton to dispose of.

Morando declines to predict sales figures for the process: "Most of these applications don't even exist yet, and we're still looking for specific problems to solve. But we know that handling toxic wastes now costs billions of dollars a year, and that ceramic coatings comprise a market of at least $20 million a year."

Other licensing arrangements are also in the works. For instance, last year a major U.S. pharmaceutical company, which is keeping its identity under wraps, licensed a vaccine-releasing chewing gum from the Czech drug company Velim. The gum, called Sevak, combats early cold symptoms and has been on the Eastern European market for several years, according to Richard DiCicco, president of Technology Catalysts of Falls Church, Va., which arranged the licensing agreement. The product is now beginning clinical trials in the United States, and could be available by prescription by 1991. The market is estimated at $600 million a year.

The new interest in Soviet-bloc technology also has had side effects for such companies as Kiser and Technology Catalysts, which can help arrange such deals. Kiser is one of a growing number of consulting firms that specialize in helping companies license technology from other countries.

"There are more licensing consultants coming into the field every day," says John W. Morehead, whose Technology Search International consulting company was founded in 1981. Four years ago, when he started keeping track, Morehead counted about 250 licensing consultants. Today the list contains about 1,700.

But sometimes the promise of a big payoff is not enough to lure U.S. businesses into a venture with Soviet-bloc countries. Some potential agreements fall through when companies grow tired of the long delays and red tape that afflict such deals.

"Communications are much slower in Eastern Europe than in the West," says Morehead. "You might get a response from Western Europe in a few weeks, but you might not hear from a bloc company for months, if ever."

"A lot of Americans get fed up with the hassles," says Leo Welt, president of licensing consultants Welt International. "For the company that's serious about acquiring technology from the Soviet bloc, my advice is to take a deep breath; don't assume you can just get in and get right out again."

But for companies that have done their homework and found a product or process unavailable in the West, says Welt, "the payoffs will make it all worthwhile." ■

H. Garrett DeYoung is a freelance writer who specializes in science, technology, and business.

SUPERHEATED PLASMA

PLASMAFUSION
Box 299
Grasse Ile, MI 48138
(313) 675-9536

Founded
1982

1986 revenues
Not available
(privately owned)

Primary business
Industrial coatings

Company's market value
Not available

Technology used
A process that uses water to create a plasma —a high-temperature cloud of charged particles

Technology's origin
Czechoslavakia

Market
A variety of industrial processors, including companies that incinerate toxic wastes, make ceramic parts, and heat-treat steel-processing equipment for longer life

SOURCE: HIGH TECHNOLOGY BUSINESS RESEARCH

CHEMICAL PROCESSING

SENETEK
444 Castro St.
Mountain View, CA 94041
(415) 962-0925

Founded
1983

1986 revenues
$11,733

Primary business
Biotechnology research

Company's market value
$38.8 million

Technology used
A water-absorbing plastic called HEMA

Technology's origin
Czechoslavakia

Market
Labaratories and process plants that use chromatographic sarbents, which separate elements of a chemical mixture

SOURCE: HIGH TECHNOLOGY BUSINESS RESEARCH

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THE COMPANY NEWSLETTER

All-Stars Clinch Division Title

Heavy hitting powers All-Stars to the top

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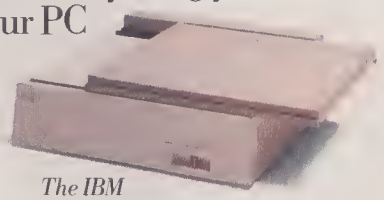

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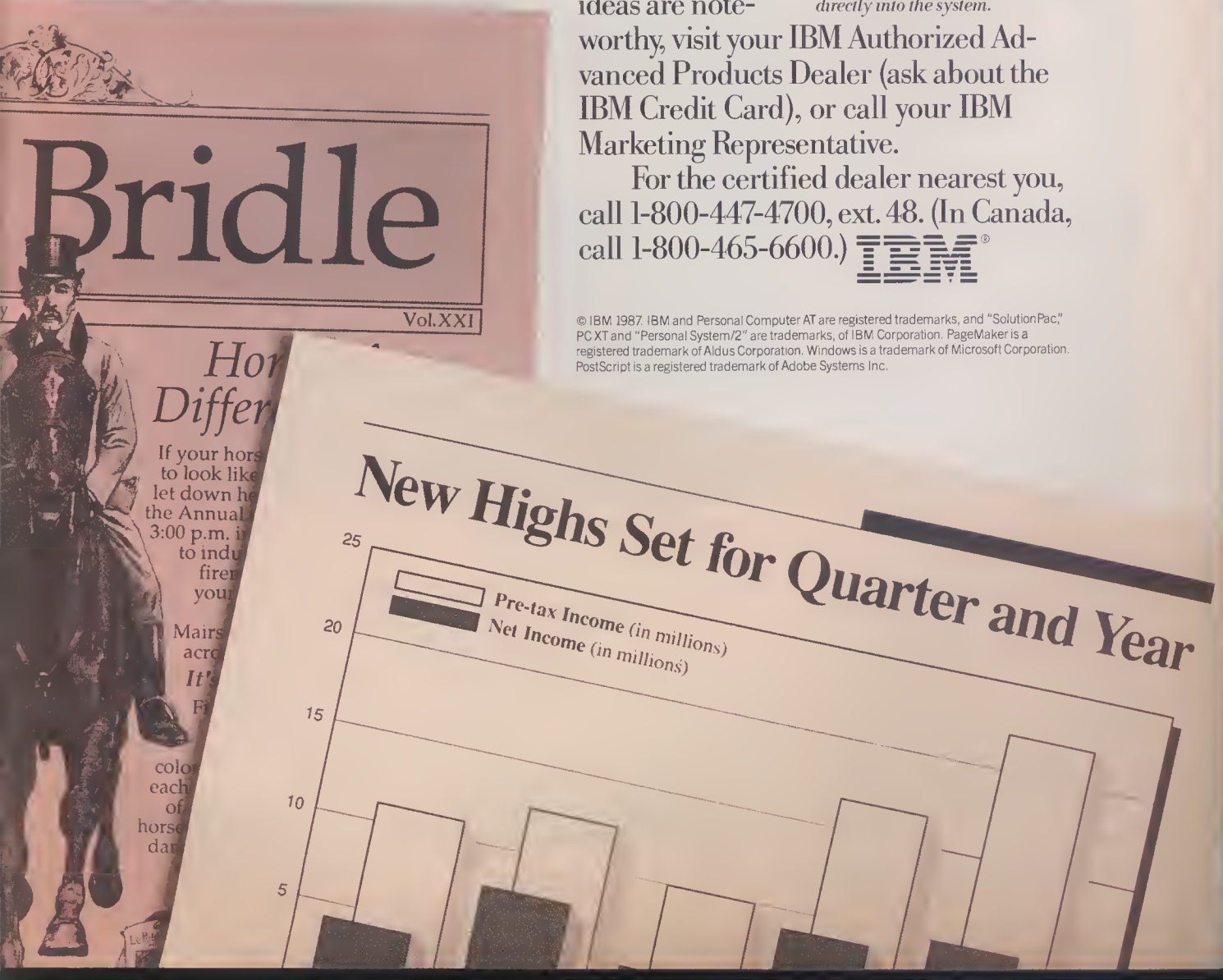


Air Reservations

New Savvy In the Skies

Sophisticated airline reservation and ticketing systems are making the skies friendlier

By Helen Wheeler

American's Max Hopper spearheads his company's search for new ventures.

THE EFFECT OF deregulation on commercial airlines is reflected in one simple statistic. In 1977, when airline rates and schedules were still under the thumb of the Federal Aviation Administration, travel agents booked 38 percent of all airline flights. Last year, that figure more than doubled.

As predicted, nearly 10 years of deregulation has spurred heavy competition among airlines. And as the booking statistic shows, it has also increased interest in anything that can help confused travelers deal with plane reservations, ticketing, baggage handling, and travel expenses. As a result, many of the major airlines, on the lookout for new ways to attract passengers, are adding sophisticated technology to price-cutting and flight schedules as ways to stay competitive.

Today's reservation systems not only let travel agents book flights, hotels, and car rentals, but may also provide computerized ticketing, automated baggage tracking, and electronic check-ins. Several systems now give the business traveler the same computerized search abilities a travel agent has. Some systems even use booking information to help companies keep track of travel and entertainment expenses.

Computerized reservation systems have been around since the 1960s in much simpler forms. However, only in the last decade have airlines with the foresight to develop their own computer systems reaped the rewards. Airlines are fighting to sell their systems to as many travel agents as possible; an estimated 90 percent of all agents are connected to at least one of them. Providing more and better services to agents is important—systems tend to list the flights of the airline that owns them first, so agents are more likely to book passengers on the airline whose system they use.

But computerized reservations bring in more than passenger revenue; the systems themselves also are highly profitable. Per dollar spent, airlines make more money on reservation systems than they do on flying passengers. Edward Stockman, an airlines analyst at Paine Webber, says that in a good

ZIGY KALUZNY/GAMMA-LIAISON

Texas Air's System One, led by executive v.p. Edward Gehrlein, is expanding rapidly.

quarter the airlines have an 8- to 10-percent profit margin overall, while computer reservation systems make as much as 20 percent profit.

As a result, the few airlines that have developed such systems are selling them to other airlines. And at least one airline, American, is also beginning to sell information obtained by computerized reservation systems to businesses outside the travel industry.

Computerized systems all have a central computer and database to which the travel agent's terminals connect. Those airline computers in turn are linked with computer systems at other airlines, hotels, and rental-car agencies in a variety of ways. If two airlines do enough business with each other, they may have a private data network that operates over telephone lines or by satellite transmission; the same is true of links between individual airlines and rental-car companies, for example. For relatively infrequent communications, airlines also use a data-transfer service called Airinc, which is owned by the airline industry. Robert Covell, senior director of data services for Airinc, says the service also transmits information between computers over telephone lines and satellites, using a standard protocol to which all airlines adhere.

The bulk of the business for computerized reservation systems lies with travel agents, and American Airlines is

DAVID WAGENAAR

Barry Kotar, president of United's Covia subsidiary, says price is only one competitive factor for reservation systems.

by far the leader in the field. Its Sabre service now has contracts with about 36 percent of the estimated 27,000 travel agents who use such systems. Many were lured by accounting and other services that help travel agencies operate more efficiently.

However, American and other airlines are now targeting corporations and individuals as potential customers for commercial versions of the computerized systems aimed at travel agents. For example, American's Commercial Sabre, inaugurated in January, lets a company book flights and hotel reservations or rent cars directly through the Sabre system via modem. A company can use Sabre software on its own terminals and modems to pull information on flight schedules, fares, hotel vacancies, and weather from Sabre's main computer, based in Tulsa, Okla. A company can also bypass a travel agent and enter reservations directly into the system's main computer.

Another service, EAAsy Sabre, has been in operation since late 1985 through such on-line information services as CompuServe, Delphi, Dialcom, General Electric Information Services, GEnie, and QuantumLink. Subscribers to one of those networks need only type an access code into a personal computer to get into the system and make their reservations; the cost is generally figured by the amount of time spent on the network. However, because American still has a vested interest in retaining business from travel agents, a company that uses either Commercial or EAAsy Sabre must still go through a travel agent to get the ticket.

At least one airline is beginning to sell information obtained by computerized reservation systems to businesses outside the travel industry.

Sabre has been extremely lucrative for American; in 1985 the system's profit margin was 40 percent. Lately, however, those profits have been squeezed by the need to compete with the lower prices and incentives offered to travel agents by other systems. "Although our revenues were substantial, we are coming down to lower margins," says Max D. Hopper, senior vice president of AMR Information Systems. In 1987, he says, the airline is looking at 20 percent, but he points out, "Even a 20-percent margin is good."

Other companies also are beginning to sell reservation systems to corporate customers. A joint venture of TWA and Northwest called PARS, Texas Air's System One, Delta's Datas II, and United Airlines' Covia subsidiary all offer corporate customers systems to review fares and flight schedules. However, as with American, travel agents must still issue the tickets.

So far, companies have not rushed to take advantage of the new services. "There has been very slow growth with this product," says Martha Zalkind, vice president of product planning for PARS, which was introduced in 1985. However, she says, PARS executives feel corporate systems will be important in the future and plan to keep them on the market.

Texas Air's System One also includes a self-service ticketing system called JetSet, which works much as automated teller machines do. But Texas Air is not aggressively marketing the product. "Acceptance has been low and there has been no overwhelming demand for the service," says Edward A. Gehrlein, executive vice president and chief operating officer.

Many computerized reservation systems offer an added bonus: software that lets companies program their travel policies into the selection process and track travel expenditures more closely. For example, Covia's Focalpoint software takes into account a company's restrictions on airfares and hotels. System One also has such software, and Sabre is in the process of introducing its version. American recently introduced a service called Capture that creates automatic travel-expense records by transmitting booking information from Sabre to a traveler's home office.

"Systems have to compete on something other than price," says Barry A. Kotar, Covia's president.

United and American, the market leaders, are keeping an eye on System One, the Texas Air subsidiary. Formed a little more than a year ago, System One has about 16 percent of the market for reservation systems. However, it has aggressively carried the battle for

reservation-systems dominance to Europe. This summer it beat out American for a $300-million contract to set up a computer reservation system for Lufthansa, Air France, and several other European airlines.

The benefits of computerization do not stop once a reservation is made; automation can also ease the tortures passengers may suffer once they get to the terminal. United, whose Covia subsidiary has about 25 percent of the market for reservation systems, has begun to demonstrate the capabilities of such systems in its "terminal of tomorrow" at Chicago's O'Hare airport.

The system, to be completed over the next year, may ultimately consolidate information about flights, hotel reservations, car rentals, and baggage claims on one ticket that also serves as a boarding pass. The information would be encoded on a magnetic strip on the back of the boarding pass at the same time reservations are made through the Covia system. The magnetic strip contains a binary code that is read and transmitted to a central computer. The strip, which initially will contain only flight and airline reservation data, could also match information with bar-code stickers attached to luggage. These stickers let the airlines trace an individual bag from the check-in counter to the baggage-claim area at the traveler's destination. As a piece of luggage is loaded on a plane, it first passes under an optical scanner that uses lasers to read the bar code and transmits the information to a computer in the terminal. The computer determines which belts the bag should travel on and pushes it toward the appropriate belt with a robot arm that can move 480 bags a minute.

Per dollar spent, airlines make more money on reservation systems than they do on flying passengers.

■

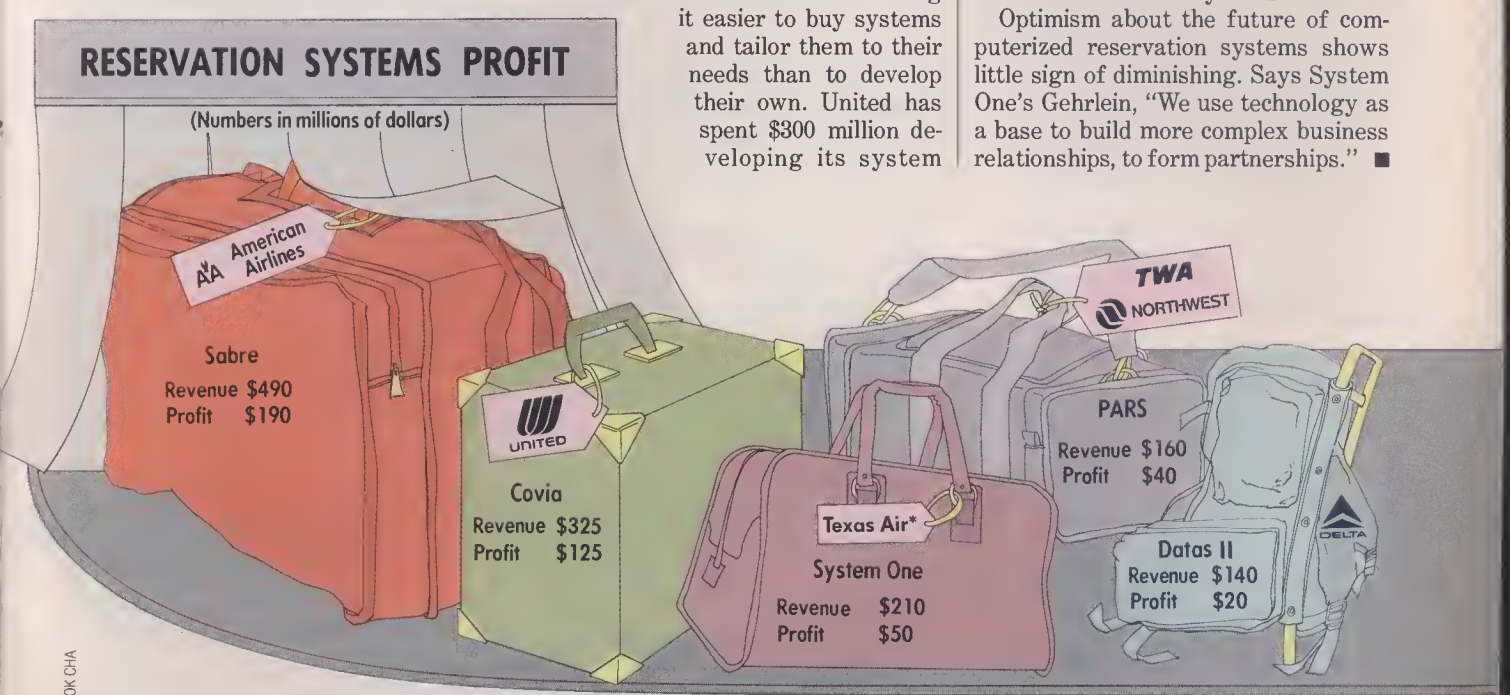
So far, the encoded tickets are being issued mainly at the United terminal; more widespread use will depend on how well Covia is able to sell travel agents on the special ticketing machines needed to issue them. Also on the way is a system that will scan passengers' tickets as they board the plane.

Because of the huge capital outlay required by computerized systems, the companies who have already established solid market position are expected to remain dominant. Other airlines are finding it easier to buy systems and tailor them to their needs than to develop their own. United has spent $300 million developing its system and will invest $120 million to build one for its new European partners; Covia recently signed an agreement with British Caledonian, Alitalia, and several other European airlines to automate their systems. Texas Air will spend several hundred million dollars over the next five years to develop System One.

Airlines also are beginning to realize that they can make money by selling their databases, telecommunications, and accounting systems to companies other than airlines and travel agents. AMR Information Services, a subsidiary of American Airlines' parent company, has been the most aggressive in pursuing such sales. AMR's most successful ventures so far have been a direct-marketing corporation, which made $40.1 million last year, and Caribbean Data Services, which enters data from paper sources into computer systems for commercial customers as well as American Airlines. The information services group also includes units that create in-house computer systems for other airlines, arrange entertainment reservations and tickets, and provide home banking and telephone bill-paying systems for financial services.

"We expect the whole group to be profitable by 1989," says AMR's Hopper. Such expansion is not a high priority for most other airlines, which either have only a few scattered outside ventures or are still planning what could be done with their own reservation systems.

Optimism about the future of computerized reservation systems shows little sign of diminishing. Says System One's Gehrlein, "We use technology as a base to build more complex business relationships, to form partnerships." ■



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*Data available from Continental and Eastern only. People Express and New York Air acquired at end of 1986.

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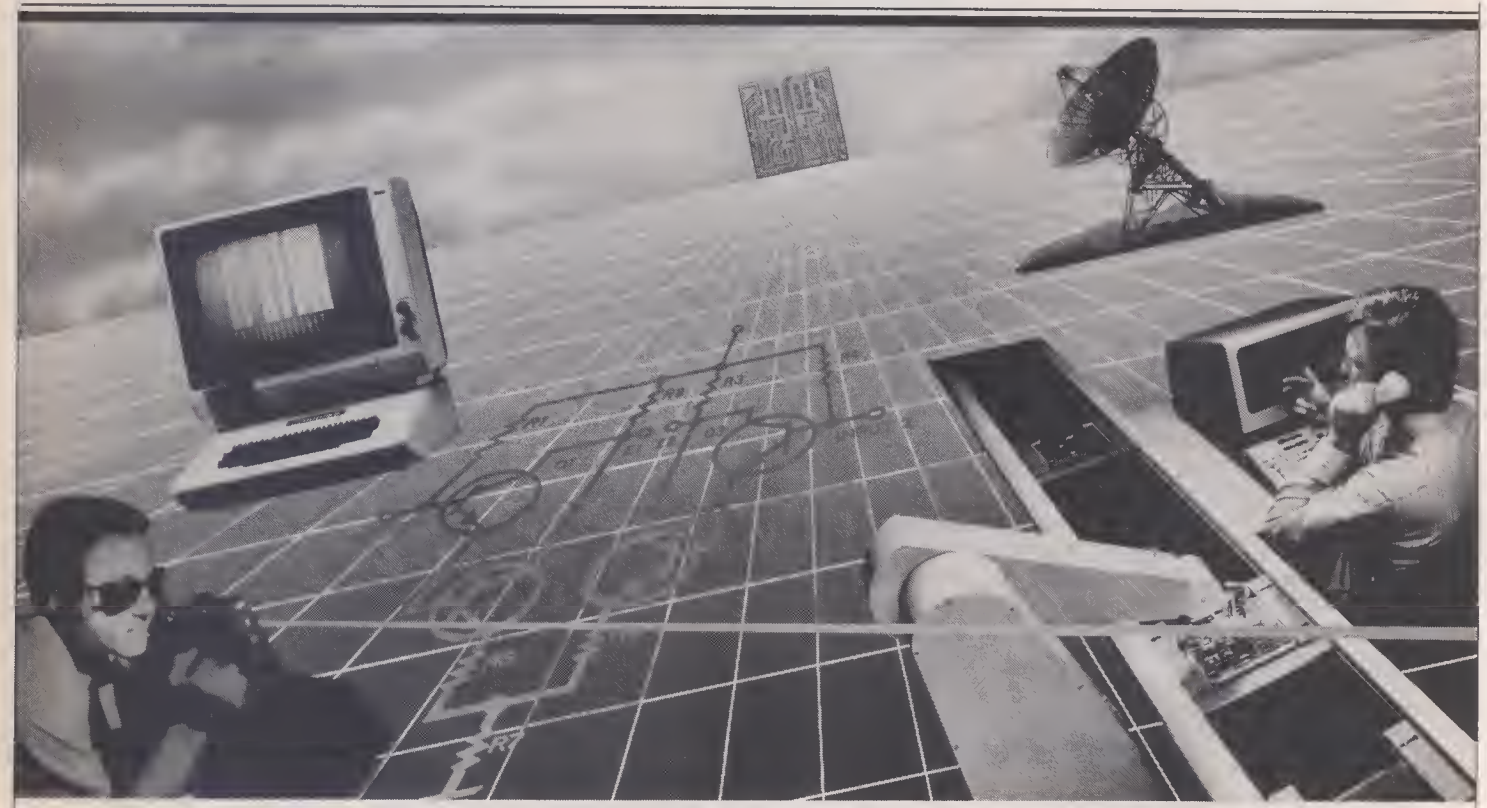

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Big Hopes For Small Dishes

As voice traffic shifts from satellites to fiber optics, the satellite industry finds new applications

BY HERB BRODY

WAITING IN THE checkout line at K Mart used to be a gamble. Customers unlucky enough to get stuck behind shoppers using credit cards found the line brought to a standstill as the clerk laboriously called to verify each card. Store managers often watched potential customers walk out in frustration.

Attention, K Mart shoppers. A new $60-million communications system now being installed will enable all 2,100 K Mart stores to verify credit by satellite links to remote databases. The system will also transmit daily reports and corporate video, according to Walter Bzdok, K Mart's senior director of corporate communication and systems reliability. More than 50 stores have been hooked up so far.

Such networks are doing more than easing shopping trips. They are one of the few bright spots in the $4-billion satellite-communications business, and are generating new capabilities that were unheard of only a few years ago.

Hope is sorely needed in the satellite industry, whose early promise has suffered lately from a series of setbacks.

JOSÉ CRUZ

WHO'S WHO IN COMMUNICATIONS SATELLITES

JOSÉ CRUZ

■ SATELLITE MAKERS

British Aeraspace
11 Strand
Landon, England
1-930-1020

GE Astra-Space Div.
Bax B00
Princetan, NJ 0B543
(609) 426-3400

Hughes Aircraft
Bax 92919
Las Angeles, CA 90009
(213) 64B-0942

■ SATELLITE OWNERS/OPERATORS

AT&T
Raute 202/206
Bedminster, NJ 07921
(201) 234-4346

Communication Satellite Co. (Camsat)
950 L'Enfant Plaza S.W.
Washingtan DC 20024
(202) B63-6010

Cantel/ASC
1B01 Research Blvd.
Rackville, MD 20B50
(301) 251-8333

GE American Communicatians
4 Research Way
Princton NJ 0B540
(609) 987-4000

GTE Spacenet
1700 Old Meadaw Rd.
McLean, VA 22102
(703) 790-7700

Hughes Communicatians
Bax 92424
Las Angeles, CA 90009
(213) 607-4117

Satellite Business Systems
B2B3 Greensbara Dr.
McLean, VA 22102
(703) 442-5000

Telesat Canada
333 River Rd.
Ottawa, Ontaria,
Canada K1L8B9
(613) 746-5920

Western Unian
1 Lake St.
Upper Saddle River, NJ
0745B
(201) B25-5000

■ SERVICE PROVIDERS (DO NOT OWN SATELLITES)

Banneville
19 W. South Temple
Salt Lake, UT B4101
(B01) 322-4400

Cylix Communicatians
B00 Ridge Lake Blvd.
Memphis, TN 3B119
(901) 761-1177

EDS Communicatians
6430 Rackledge Dr.
Bethesda, MD 20B17
(301) 564-3200

Private Satellite Network
215 Lexingtan Ave.
New Yark, NY 10016
(212) 696-9476

Tridam
B40 E. Franklin Ct.
Marietta, GA 30067
(404) 426-4261

VideaStar Cannectians
3390 Peachtree Rd.
Atlanta, GA 30326
(404) 262-1555

Xerax Camputer Services
5310 Beethaven St.
Las Angeles, CA 90066
(213) 306-4000

■ MOBILE-COMMUNICATIONS SERVICES

Aviation Satellite (AvSat)
2551 Riva Rd.
Annapalis, MD 21401
(301) 266-40B1

Geastar
1001 22nd St. N.W.
Washingtan DC 20037
(202) BB7-0B70

Hughes Communicatians
Bax 92424
Las Angeles, CA 90009
(213) 607-4117

MCCA American Satellite Services
Bax 2367
Jacksan, MS 39225
(601) 969-1200

McCaw Space Technalagies
409 S.W. Ninth
Portland, OR 97205
(503) 274-61B0

Mabile Satellite
900 East Bth Ave.
King of Prussia, PA 19406
(215) 265-B11B

Narth American Satellite
733 3rd Ave.
New Yark, NY 10017
(212) 6B7-0055

Satellite Mabile Telephane
57 East 11th St.
New Yark, NY 10003
(212) 460-5022

Skylink
1B00 30th St.
Boulder, CO B0301
(303) 442-BB66

Transit Communicatians
505 E. Calarada
Pasadena, CA 91101
(B1B) 577-B720

■ EARTH-STATION MAKERS

Andrew
110500 W. 153rd St.
Orland Park, IL 60462
(312) 349-3300

Califarnia Microwave
990 Almanor Dr.
Sunnyvale, CA 94086
(40B) 732-4000

Equatarial Communicatians
300 Fergusan Dr.
Mauntain View, CA
94043
(415) 969-9500

Fairchild Data
350 N. Hayden Rd.
Scottsdale, AZ B5257
(602) 949-1155

Harris Business Cammunicatian Systems Div.
1301 Woody Burke Rd.
Melbaurne, FL 32901
(305) 724-3000

Harris Gavernment Aerospace Systems Div.
Bax 94000
Melbaurne, FL 32902
(305) 727-4000

M/A-Cam Telecammunicatians Div.
11717 Explaration Lane
Germantawn, MD
20B74
(301) 42B-5500

NEC America
Radia Transmissian
14040 Park Center Rd.
Herndan, VA 22071
(703) B34-4000

Oak Communicatians Satellite Systems Div.
16516 Esprilla Rd.
San Diega, CA 92127
(619) 485-9300

Scientific Atlanta
Bax 105600
Atlanta, GA 3034B
(404) 441-4000

Tridam
B40 E. Franklin Ct.
Marietta, GA 30067
(404) 426-4261

Vitalink Cammunicatians
6607 Kaiser Dr.
Fremant, CA 94555
(415) 794-1100

First there was the demise of the space shuttle Challenger and a string of rocket-booster failures. Without adequate mechanisms for getting equipment placed in space, satellite companies have found themselves "all dressed up with no ride to the party," says Raymond Williamson, a senior analyst at the U.S. Congress' Office of Technology Assessment. In addition, higher insurance rates caused by the rocket failures have weakened the industry's competitive position. Because insurance is jacking up the price of increasing satellite capacity, fewer satellites are likely to be launched.

More significant has been the continued incursion of fiber optics into the telephone network. Long-distance traffic currently accounts for almost 40 percent of satellite use, but fiber optics, which uses beams of light to transmit information, carries telephone traffic more efficiently than do satellite links. Because their lightwave signals don't have to travel up to an orbiting satellite, fiber-optic networks also avoid the annoying delays that plague satellite transmission.

As long-distance carriers complete their fiber-optic networks, more and more long-distance telephone calls are shifting to land line transmission. And, over the next three years, several new fiber-optic cables will be laid across both the Atlantic and Pacific oceans, gobbling away another giant slice of satellite business.

As a result, satellite-communications companies are desperately searching for new business to replace the vulnerable voice traffic. Most analysts and industry insiders say the future of the satellite-communications industry lies in uses made possible by very-small-aperture terminals, or VSATs.

These compact antennas, usually only two to six feet in diameter, are cheaper, easier to install, and less likely to be banned by urban zoning rules than conventional satellite dishes, which measure as much as 10 feet across. Because of these advantages, VSATs have given birth to several new uses that may help breathe new life into the satellite business. For example, private data networks use them to help companies send computer data to widely scattered locations. VSATs also have spurred the growth of business television, which enables businesses to broadcast information specific to a company or industry at relatively low cost.

The VSAT corner of the satellite business is comparatively tiny, but it is one of the few areas enjoying significant growth. In the last three years VSATs have dropped dramatically in cost, so that a fully equipped, two-way VSAT earth station can now be had for as little as $10,000. That price drop should help push the total VSAT market—equipment sales as well as fees for communications services—from $100 million in 1985 to almost $300 million this year, according to Link Resources, a market-research firm. By 1990, Link forecasts, the VSAT business will top $750 million.

■

The future of the satellite-communications industry lies in uses made possible by very-small-aperture terminals, or VSATs.

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Perhaps the most significant aspect of the new VSAT uses has been the push by satellite-communications businesses to offer private data networks rather than concentrating on transmission services for television stations and public-network telephone companies. The first wave of VSAT users consists mainly of financial institutions and retail chains—businesses that tend to operate large numbers of geographically dispersed facilities. K Mart will have the biggest network, but other customers include J.C. Penney, Merrill Lynch, and Southland Corp., which owns the 7-Eleven stores.

The chase for new dollars has triggered a furious round of mergers and acquisitions in the satellite business. The prime example is Contel, which several years ago bought American Satellite Co. In 1986, this merged entity, now known as Contel/ASC, doubled its size by acquiring the government-networks division of Western Union.

Then, in a pair of lightning strikes this summer, Contel/ASC bought two organizations known for their avant-garde satellite work—Equatorial Communications and Comsat Technology Products, the division of Communications Satellite Corp. that manufactures VSATs. These moves give Contel a daunting 60-percent market share in the VSAT business. The company's spate of acquisitions mark the "culmination of our strategy" to become a major VSAT force, says George Roberts, president of Contel/ASC.

Despite its newfound market strength, Contel has its work cut out for it; neither Equatorial nor Comsat Technology Products were profitable.

Although Equatorial pioneered VSAT technology, the company has not made money since 1985. The Contel acquisition will partly alleviate one of Equatorial's problems, that of excess capacity. "They were doing all right until they bought half the transponders on the Galaxy 3 satellite," says Roberts. (A satellite's transponders detect signals from an earth station on the ground and retransmit them to earth stations on the link's receiving end.) Equatorial found itself with more transponder capacity than it could sell, but Roberts says Contel will use some of the idle transponder capacity for its own services.

The other object of Contel's summertime spree amounts to a booby prize of sorts. Contel and Comsat had planned to merge, but Contel backed out and former Contel president John Lemasters was replaced by Don Weber in the aftermath of the merger's collapse. "It didn't work out and the gentleman is no longer here," says Weber. "Draw your own conclusions."

Other companies are consolidating to mount challenges to Contel's dominant VSAT position. AT&T is trying to buy some of the assets of satellite-maker Ford Aerospace Satellite Co.; the communications giant hopes to gain access to some of Ford's allotted satellite locations in space. Scientific Atlanta, a top producer of satellite dishes, wants to buy Advanced Communications Inc., which makes VSAT electronics.

The alliance with the most potential is that of Hughes Communications, a subsidiary of General Motors' Hughes Aircraft unit, and M/A-Com, the leading manufacturer of the most compact

breed of VSAT, which operates on a higher frequency. Hughes' agreement to acquire part of M/A-Com will give it an awesome array of capabilities. It already manufactures satellites and supplies satellite-communication services, mainly for network and pay-television broadcasts, and a sister company—GM subsidiary Electronic Data Systems—also sells satellite services.

The other major contender is attempting to go it alone. GTE Spacenet, which will supply K Mart's network, is the top supplier of high-frequency satellite networks. GTE is so optimistic that it has circumvented the shortage of launch vehicles by contracting with the French Ariane rocket to send up two new satellites by May.

Despite growing interest, satellite data transmission is not without technical problems. The same quarter-second signal-transmission delay that annoys users of satellite voice circuits slows the flow of data, too. One-way data broadcasts generally work fine, but the delay can be significant in two-way exchanges, which require constant communication between both ends of the link to ensure an accurate signal.

Data networks may be growing faster than other segments of the satellite market, but video still represents the bulk of communications satellite use. The widespread installation of VSATs has pried open the door to new video services. For example, companies can now beam proprietary or industry-specific programming from a central site to many remote locations. Called "business television," these one-way video transmissions usually are accompanied by two-way telephone hookups so viewers can interact with the show's hosts.

The number of business-television networks is exploding as corporations become more comfortable with VSAT technology. At the end of last year, 41 networks that broadcast to 5,500 receiving sites had been set up, according to consultant Eliot Gold. By the end of this year, says Gold, more than 50 networks and 11,000 reception sites will be operating. Companies using business television include Allen-Bradley, ComputerLand, Digital Equipment, Domino's Pizza, Eastman Kodak, Federal Express, Ford Motor Co., Hallmark, Hewlett-Packard, IBM, J.C. Penney, Merrill Lynch, Texas Instruments, and Wang Laboratories.

The major VSAT players—Contel/ASC, GTE Spacenet, and AT&T—are all involved in business television. However, a cadre of small specialty companies, such as Private Satellite Networks (PSN) and VideoStar Connections, have also staked a claim.

Many companies use business television to train new employees. Novices can watch an expert perform a task and get questions answered on the spot. A company president or marketing chief can explain a new product's features to a widely scattered sales force without spending time and money to fly them all to headquarters.

Programming that transcends corporate boundaries is also becoming popular. Several networks cater to the information interests of professionals, such as lawyers and accountants. The idea is also spreading into other business segments. The Automotive Satellite TV Network, for example, transmits daily programming to car dealers. Because they have a constant turnover in salespeople, these dealers benefit from centrally produced TV programs that can explain what's new in car models or financing options.

"It's selling like wildfire because it meets a need," reports Susan Irwin, a consultant who specializes in private communications networks.

Medialink of Pasadena, Calif., is rolling out a similar network for growers, wholesalers, and retailers in the $300-billion food industry. Thirty companies have committed to using the network in 20,000 stores, according to Medialink president Meres McCarroll.

Business television is cheaper than

THE VSAT DIFFERENCE

Conventional satellite communications require 10-foot antennas, which are expensive, difficult to install, and unsightly. But today's VSATs—very-small-aperture terminals—work with antennas only two to six feet in diameter.

A VSAT network has three parts: the hub, the satellite, and the remote terminals. At the hub, a transmitter sends signals to the satellite, which rains the same message down to the terminals. In the first generation of VSAT networks, these terminals functioned solely as receivers. Now, however, many VSATs offer two-way, interactive communication services.

The smaller size of VSATs makes them practical in a wider variety of locations than their outsized cousins. Many retailers and small offices are strapped for space, and full-size earth stations would require them to rent or buy a site for the satellite dish. VSATs, on the other hand, can often be placed unobtrusively on the roof.

Apart from being less obtrusive, the key advantage of smaller earth stations is the cost. As the dishes proliferate, economies of scale have reduced the cost of a typical VSAT station to as little as $10,000 installed. At that price, companies can afford to equip large numbers of remote locations, even if the traffic volume is not particularly heavy. Because the hub is expensive—typically $1 million—the economics of a VSAT network improve with the number of remote terminals.

A smaller dish has its price, however; signal reception gets worse as the antenna shrinks. To compensate, the VSATs now becoming popular operate in a different part of the radio-frequency spectrum. Conventional, full-size systems use the C-band: 6 gigahertz for ground-to-satellite and 4 gigahertz for the downlink. The new generation of VSATs uses the Ku-band: 14 gigahertz up, 12 gigahertz down. The high-frequency Ku-band waves are shorter than C-band waves, and therefore can be detected by a proportionately smaller antenna.

Another reason to use the Ku-band for smaller antennas is that its frequencies are less subject to interference. Terrestrial microwave systems use C-band frequencies, but the Ku-band has been reserved strictly for satellite use. On the other hand, critics of Ku-band systems point out that heavy rain has been known to interfere with the shorter waves. ■

scheduling hundreds of live presentations, but it can still be expensive. Teaming it with other satellite services, however, can substantially improve the economics. For example, GTE Spacenet uses part of its satellite capacity for business television during the workday; come evening, the same transponders are rented to news-gathering operations, allowing far-flung correspondents to feed stories to their stations. This dual use is "a very important part of our strategy," says Spacenet president C.J. Whalen. "Revenue from the news-gathering operation makes the business TV possible."

The markets for VSATs and business television support one another. From one standpoint, the widespread installation of these petite satellite dishes helps make business-TV networks practical. In addition, the possibility of enhancing a VSAT data system to transmit video can spur customers into buying a private data network more quickly, says Contel/ASC marketing manager Susan Kalla. Contel/ASC expects that half of its VSAT customers will use the systems for business television as well as for data, according to Kalla.

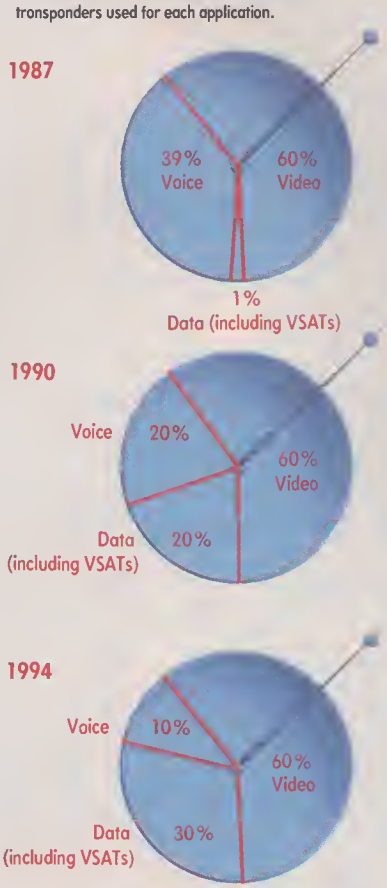
Such dual uses are clearly the communications-satellite business' hot ticket for the next several years. However, long-term prospects could hinge on another new application of satellite technology: mobile communications.

Mobile services now under consideration would use satellites to relay voice signals to and from portable radio transmitter/receivers; they would then link these signals to the public telephone network. Although they could be used in much the same way as today's cellular telephone systems, the mobile satellite networks would not depend on a network of cell sites on the ground, and could be used anywhere with a direct line of sight to the satellite. The systems are expected be most effective in rural areas, away from tall buildings and mountains that might interfere with the direct line to the satellite.

Proponents of the new technology say customers will be able to call any place in North America for about 15 cents a minute. The systems would automatically locate vehicles for companies that need to keep in constant touch with traveling employees. The satellites could also be used for air-traffic control, security surveillance, and basic telephone service in remote rural areas.

WHAT COMMUNICATIONS SATELLITES DO

Percentages refer to the number of satellite transponders used for each application.



SOURCE: CONTEL/ASC

However, satellite-based mobile communication services are not imminent. Questions still center around how big an antenna would be needed, and how large an antenna could be mounted on a car or truck. The smaller the antenna, the more broadcasting power the satellite would need to ensure clear reception. In addition, the mobile-satellite providers would need to launch new satellites to handle the service, and the shortage of launch vehicles threatens to delay those plans.

Unresolved regulatory issues also could stall satellite mobile communications. Two groups of companies have filed separate applications for permission to operate full-scale systems. One consortium includes Hughes Communications, MCCA American Satellite Services, McCaw Space Technologies, Satellite Mobile Telephone, and Skylink; the other group consists of Mobile Satellite, North American Satellite Services, and Transit Communications. Each of the eight organizations has put up $5 million in seed money.

The Federal Communications Commission, which had earlier requested a single application, dismissed the two bids and ordered the eight companies involved to form a single joint venture. No such compromise had been reached by mid-September. Still, assuming that this hurdle can be overcome, satellite-based mobile communications services could be in operation as early as 1990, say FCC officials.

The motivation to get into the market is strong, even if the companies have to play by the FCC's rules. The potential market for such a service comes to $500-$700 million, estimates John E. Koehler, president and CEO of Hughes Communications.

On the international front, British Airways is planning to test a satellite mobile service next year that would provide air-to-ground communications from its international flights. Inmarsat, the international maritime satellite organization, already offers a similar service for ships, and British Airways will use Inmarsat's satellites. In addition, AVSAT, a spin-off of Aeronautical Radio Inc. (ARINC), claims that at least 14 airlines have invested in its plans to build a $1.4-billion, four-satellite network to provide telephone service on international airline flights. However, AVSAT is competing with the two land-based satellite consortia for the same piece of the radio-frequency spectrum, and the two systems may not be able to coexist.

One precursor to mobile satellite systems—radio determination—is already available from Geostar. This service uses satellites to track vehicles, primarily trucks, and it's beginning to transmit limited amounts of data as well as locations. Other companies, including MCCA Radiodetermination, McCaw Space Technologies, and Omninet, have expressed interest in the radio-determination concept.

New technologies and applications such as data communications, VSATs, business television, and mobile services still represent only a small part of the overall satellite communications industry. However, if they prove to take better advantage of satellite communications' ubiquity and mobility, they are less likely to leave the industry vulnerable to technological marauders such as fiber optics. ■

AT&T Chairman James Olson

On Exporting U.S. Technology

It's a long way from cleaning out manholes in North Dakota to leading the charge of a $34-billion company into the international technology marketplace. James E. Olson spent 44 years making the transition from telephone-line worker at Northwestern Bell to chairman of AT&T, and the company he took over a year ago is far different from the one he started with in the 1940s. When AT&T shed the Bell operating companies—the locals where Olson started—the company turned to a worldwide strategy that integrates telecommunications and data processing into a unified "systems sell."

But AT&T has found its entry into the computer business tougher than anticipated, and the overseas market push is still searching for its first big success. Losses in the equipment division last year are estimated to have approached $1 billion. In light of Olson's emphasis on making AT&T a global power in information technology, HIGH TECHNOLOGY BUSINESS assistant managing editor Fredric Paul talked with him about competing in the world market.

■ *HT Business: Where does the international market fit into AT&T's plans?*

OLSON: Our vision is to be a global leader not only in our traditional information movement business but also on the information management, or data processing, side. And the third leg of the stool, obviously, is the international arena. AT&T

JOYCE RAVID

can get additional growth opportunities by aggressively going after the international marketplace.

We've been in the international long-distance business for years. We are the market leader. We connect the United States to some 200 countries. Western Electric (the equipment-manufacturing arm of the old Bell System) owned and operated factories around the world until early in the century. The management of the old AT&T made the decision in 1925 to sell the offshore facilities to ITT. And ITT recently sold its telecommunications business to the French Compagnie Generale d'Electricite.

Now, in the late 1980s, AT&T has aggressively gone back offshore to establish itself in the provision and manufacturing of systems that local telephone companies need, as well as PBXs and computers. The triad of Europe, North America, and Japan is the main emphasis; 80 to 90 percent of the information movement and management marketplace is in that triad and a few other locations in the Far East.

■ *HT Business: Despite your efforts, AT&T hasn't been as successful internationally as it had hoped. Why not?*

OLSON: One basic problem is that most of our systems deployed in the United States were designed and marketed for the United States. What we've learned is that not all the systems designed for the U.S. market would necessarily fit in Europe, or in Japan, or in many other parts of the world.

So the longer-term strategy for AT&T is to look at any new service redesign or product redesign on a global basis. If we were going to design a new PBX, we would look at the U.S. market and make sure we understood what the customers in the United States wanted, and then look at Europe, which is a series of markets, and make sure we understood those markets as well.

■ *HT Business: Apart from the technical barriers you mention, how big a part does international politics play? Is there a level playing field?*

OLSON: The U.S. market is wide open, but not all of the telephone-company markets in the world are open. Governments are very much involved in deciding how many suppliers should be there, and that's just a fact of life.

The international market has been more difficult than we anticipated, but we haven't lost our appetite. We're still very aggressively looking in Europe for other markets, such as Spain, Italy, and Germany, but the markets for the things telephone companies buy are difficult. There are entrenched suppliers, and AT&T, over time, will just have to continue to look aggressively to find a way to serve some of those markets that we feel are important.

■ *HT Business: What about markets aside from telephone companies?*

OLSON: On the things we sell to end users, such as PBXs and key telephone systems, there again some markets are more open than others. But those markets are beginning to open in most countries.

In the computer business, we picked a European partner to be our entry for the end-user market in Europe. We chose to go with Olivetti to be our main vehicle to enter the European market, and the relationship is doing well there. Olivetti does a good job of selling personal computers and minicomputers in Europe. We're still working aggressively with Olivetti to improve the way the two companies operate.

"I think the United States has made a lot of progress in making sure it's more competitive."

■

■ *HT Business: AT&T's international experiences have been remarkably similar to those of other technology companies in the United States. What common problems do U.S. technology companies share in the export arena, and what can they do to solve them?*

OLSON: U.S. businesses can make sure their products are of high quality, make sure their products fit the foreign markets they are trying to export to, pay attention to the importance of export, and make sure their costs are competitive.

I think the United States has made a lot of progress in the last 10 years on making sure it's more competitive. I think a lot of attention was paid to the factories. A lot of companies have been aggressively attacking the way their factories operate. All of the various kinds of things that have been written about extensively: just-in-time inventory, flexible manufacturing, the velocity at which you move a product through a factory so you reduce inventories.

The United States, I think, lost sight for a few years of quality as an issue. Not so much in the final product, although even there we may have lost parts of our lead, but in quality that's built in every step of the way to get a quality product delivered at the other end. The cost of quality in the United States—by most people's estimates—had reached a level of 25 percent of the cost of the product. Far too much time and money was spent on fixing and correcting problems that came in through the whole process.

I think if you walked into AT&T's factories today versus five years ago, you'd be amazed at the cost-reduction efforts—including quality—that are now very much a part of many U.S. factories. The progress we've made over the past four years is amazing. But you could go to Ford, you could go to IBM, you could go to many U.S. companies and see the same thing. We've improved our level of competitiveness.

Are we finished? Hell no. There are a lot of smart people in the world. But now you're getting companies designing quality in every step of the way, so the cost of quality is coming down. I think we've made a lot of progress.

■ *HT Business: How important is manufacturing technology?*

OLSON: I think technology is very, very important. There was a feeling that it wasn't necessary to have a strong manufacturing base, but I think 1987 has put that to rest. We have to have a strong technology base.

Take the microelectronics field. The United States cannot afford not to stay on the leading edge of microelectronics. This gets to the argument of how you fund the research necessary to stay on the leading edge. You need a volume of business to support the research bill. You might choose not to make memory chips if you can buy them from somebody else for less, but more and more you're going to see leading-edge companies needing to use custom chips with proprietary technology. But you need to have enough total manufacturing volume to support the heavy R&D bill to stay at the leading edge of microelectronics technology.

■ *HT Business: What can U.S. businesses do to maintain their technological position?*

OLSON: I think you're going to see more cooperation between the major companies, particularly in some of the major fields, such as microelectronics.

When I look at what it costs us to fund the basic research in semiconductor technology, my own personal theory is that you're going to see more and more cooperation between even larger companies in the United States to be sure we stay on the leading edge. I think that, within certain boundaries, the government is trying to accommodate some liberalization of the antitrust laws to allow this to happen. Certainly the further away from the customer you get, the better chance you've got of not having antitrust problems.

A good example is the Sematech program, which is a consortium of U.S. semiconductor companies—including large ones such as IBM and AT&T—that have gotten together to do some development work on wafer-fabrication equipment for clean rooms. [Sematech got a special dispensation from antitrust laws in an attempt to make the United States more competitive.] The closer any cooperation gets to the customer, though, the more likely I think it is that antitrust laws will prevent it.

■ *HT Business: Why have the Japanese done so well at exporting their technology?*

OLSON: The U.S.-Japan Business Advisory Council recently held a discussion on that topic. We just met out in San Francisco, and the nature of that discussion was that U.S. companies were much more basic-research oriented, and the Japanese were much more application/development oriented. They are taking someone else's technology and doing a hell of a job producing new products with it, whether it's radios, television sets, or automobiles.

■ *HT Business: AT&T, through Bell Laboratories, has always been a leader in basic research. Has AT&T's new thrust changed that?*

OLSON: In 1987, AT&T is based more on market forces than it's ever been in its history, but we have not cut back on basic research. We spend about $2.5-$2.6 billion dollars on research, and 10 percent of that—$260 million—is for basic research. That helps us to see the flukes 10 years before they happen, as opposed to building a better gadget, which is what I call development.

Technologies that are critically important to AT&T's information movement and management strategy are still funded. We have not cut back. If you're going to be an information movement and management player, there are certain technologies you must fund: microelectronics, photonics, software, digital systems. So that's 10 percent.

■ *HT Business: How does AT&T handle the other 90 percent—the development side?*

OLSON: The rest of the Bell Labs budget is focused by markets and by customers, with bottom-line accountability resting with the head of each line of business. That person determines how much money we can afford to spend and what products, services, and developments we want to fund. Then Bell Labs executes it.

■ *HT Business: With the spin-off of Bell Communications Research to the seven regional Bell holding companies, and with 90 percent of Bell Labs funding going into development, can AT&T still make the kind of breakthroughs that made it famous and helped the United States gain its original lead in technology?*

OLSON: I think so. We're not trying to cover every piece of technology; we're covering those that are crucial to AT&T. And as long as we're studying an adequate amount of basic research in key technologies, then I think you can anticipate another breakthrough. I think Bell Labs will be able over time to demonstrate that it can find the breakthrough type of technology, whether it's hardware or software.

■ *HT Business: Where should we look for those breakthroughs?*

OLSON: You really see a continuing thrust on microelectronics. More and more things are going to be put on a chip—more systems on a chip. Basic research breakthroughs can allow that to happen faster. In photonics, the electronic speeds of light pulses traveling through fiber optics will continue to rise. I suppose a breakthrough with materials could be coming. Superconductivity has been written about extensively, and we're into that.

We, along with others, are looking aggressively to try to find ways to produce software more cost effectively, to use computer-aided tools to develop the software. One of the things we worry about is, how do you measure a software developer and how many lines of coding he or she puts out? I don't think we've seen as much breakthough in software productivity as we have in hardware productivity.

■ *HT Business: What about putting that basic research into the office where people can use it?*

OLSON: A lot of people, including ourselves, are looking at artificial intelligence and ways to simulate how the brain functions. The technologies of what you can do and what you can put in front of a person at a desk are increasing. Much more information can be made readily available there, and information that you cannot store in front of a person can be readily accessible someplace else. Once again, I think a lot of breakthrough has to come in the effort on software.

■ *HT Business: Are users waiting for new technology, or is there something else holding up the introduction of these advanced systems into the office?*

OLSON: Despite the technological advances, not all companies have been able to convince employees that this is the direction they should take. A lot of people who grew up writing out letters get mike fright when they have to dictate to a machine. So they sit there and laboriously write it out longhand. I think that's going to be a key to success—to have a system the user feels comfortable with. You've got to do it in a way so that the dogs like the dog food. ■

GET THE EDGE

In case you missed any of these stories when they appeared in HIGH TECHNOLOGY BUSINESS, here is a listing from the last six months, by category. Check the stories you want and fill in the form. Include $5 for each story to cover postage and handling.

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- ☐ Chip Takeover Targets
- ☐ Camputer Disruption
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- ☐ Pentagan Program Seeks Advanced Analog Chips
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- ☐ The Pentagon's War an Casts
- ☐ The Venerable Airship Baunces Back
- ☐ Space Statian Business
- ☐ Staying In Tauch With Subs

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MARKETWATCH

NEW COMPANIES

COMPANY (STOCK SYMBOL)	BUSINESS OBJECTIVE	FINANCING	OFFICERS	OFFICERS' PREVIOUS POSTS
Cardinal Technologies Box 7628 Lancaster, PA 17604 (717) 293-3000	To sell computer products, including RCA's high-resolution color displays, membrane keyboards, and integral-modem information terminals. The company plans to enter the computer-aided manufacturing and home-automation markets.	Undisclosed amount from first-round financing	Harold R. Kroll, president, CEO Raymond Sobieski, CFO Robert A. Norman, v.p. marketing	RCA, v.p. new-product development RCA, manager financial planning & analysis RCA, marketing manager
Ceramics Process Systems (CPSX) 840 Memorial Dr. Cambridge, MA 02139 (617) 354-2020	To develop and manufacture advanced ceramic products for use in integrated circuits, steel-mill tundish nozzles, consumer and industrial tools, and engine components.	$18 million from initial public offering	Clayton M. Christensen, president, director George A. Neil, exec. v.p. operations Grant C. Bennett, v.p. business development	Boston Consulting Group, manager Corning Japan, president Bain & Co., consultant
Design Access Ghirardelli Sq. 900 North Point San Francisco, CA 94109 (415) 885-3156	To provide graphics-design products and services that improve the appearance and impact of documents produced on desktop-publishing systems. The company will also help people select appropriate systems for their needs.	$250,000 from first-round financing by president and founder	Bruce Ryan, president, founder Mark Winter, v.p. strategic planning	Varian, director of marketing Colophon, principal (owns 100%)
Fain, Greer & Hixson 932-A N. Highland Ave. Atlanta, GA 30306 (404) 872-4552	To develop custom expert-system software from a standard support system. The software lets companies train employees to provide support service for their customers; first clients include a multinational manufacturer and a temporary-services business.	Less than $1 million from founders	Deborah Fain, founder, president Hilda Greer, founder, v.p. Charlotte Hixson, founder, v.p.	MSR, founder MSR, founder MSR, founder
Gendex (XRAY) 515 W. Edgerton Milwaukee, WI 53221 (414) 769-2888	To manufacture X-ray equipment for dental and medical uses. The company will distribute to dealers, who then resell to dentists and hospitals.	$5.5 million from initial public offering	John J. McDonough, president	Newell, senior v.p., finance
IndTech (INEC) 1275 Hammerwood Ave. Sunnyvale, CA 94089 (408) 743-4300	To design and manufacture accessory boards that enhance computing power. Currently, the company designs interface boards for IBM.	$3 million from initial public offering	Nasser Kazeminy, president, chairman Praig Erickson, managing dir. of eng. John D. Crawder, v.p. marketing	Minnesota Leasing, founder, CEO ISI Int'l, manager, dir. eng. Sears World Trade, senior marketing manager
International Microcomputer Software (IMSF) 1299 Fourth St. San Rafael, CA 94901 (415) 454-7101	To publish and market graphics and desktop-publishing software and hardware for IBM and compatible computers.	$3.5 million from initial public offering	Geoffrey B. Koblick, chairman Richard Borenstein, president Robert Myer, COO	MicroPro Int'l, legal counsel EyeStyle Optical, president Gundlach-Bundschu Winery, asst. winemaker
International Microelectronic Products (IMPX) 2830 N. First St. San Jose, CA 95134 (408) 432-9100	To design and manufacture integrated circuits tailored to customer specifications. The designs combine complex digital circuits with circuits that use cell-based design methods.	$22.3 million from initial public offering	Barry M. Carrington, president and CEO Charles S. Isherwood, senior v.p., CFO William S. Michaels, v.p. sales & marketing	American Microsystems, sr. v.p. Gould, sr. v.p. corp. services Synertek, director of sales
LDI (LDIC) 1 Cleveland Ctr. 1375 E. Ninth St. Cleveland, OH 44114 (216) 687-0100	To lease new and used data-processing equipment, including midrange and mainframe central-processing units, personal computers, and telecommunications equipment. The company also provides maintenance, repair, installation, and technical support.	$14.4 million from initial public offering	Robert S. Kendall, president Michael P. Kennedy, exec. v.p. Thomas A. Cutter, senior v.p.	Victar Computer, branch manager Computer Service Center, sales manager Burroughs, district sales manager

COMPANY (STOCK SYMBOL)	BUSINESS OBJECTIVE	FINANCING	OFFICERS	OFFICERS' PREVIOUS POSTS
Lipasome Technology (LTIZ) 1050 Hamilton Court Menlo Park, CA 94025 (415) 323-9011	To produce liposames—microscopic spheres that encapsulate drugs ond transport them to specific ports of the body.	$19.5 million from initiol public offering	Nicalaos V. Arvanitidis, choirman, CEO Stanley A. Kaplon, sr. v.p. R&D Francis J. Martin, v.p., scientist	Intosa, president American Cyanamid, exec. director of development Cooper-Lipotech, technical director
Logic Modeling Systems 2880 Zanker Rd. San Jose, CA 95134 (408) 922-0870	To create an advanced generation of hardware modeling systems, which let design engineers simulate designs for very-lorge-scole integrated (VLSI) devices, peripheral chips, and opplication-specific integrated circuits (ASICs), for integration with logic simulators.	Undisclosed private financing. Investors include Volid Logic Systems	W. Douglas Hojjar, directar L. Curtis Widdoes, president, CEO Holly Stump, director of marketing	Valid Logic Systems, president, CEO Volid Logic Systems, cofounder, v.p. Valid Logic Systems, marketing monoger
Microcom (MNPI) 1400 Providence Highwoy Norwood, MA 02062 (617) 762-9310	To design, manufocture, and service dota-communications equipment for tronsmitting over the public telephone network. Products include modems, personal-computer internol-card modems, and high-density modems.	$13.8 million from initiol public offering	James M. Dow, president, CEO Lewis A. Bergins, sr. v.p., operations Patrick L. Clark, sr. v.p., marketing & sales	Data Generol, regional sales manoger Honeywell, dir. of terminol eng. Interland, founder, v.p. sales & marketing
Monitek Technologies (MTEKU) 1495 Zephyr Ave. Hayword, CA 94544 (415) 471-8300	To produce and design measurement instruments for the inspection of liquids. Products use fiber optics and columnated beams of light to view liquid. Primory markets: poper, food, pharmo-ceutical, petro-chemicol, and municipol-water industries.	$3.7 million from initiol public offering	Kenneth E. Anderson, president Jomes S. O'Leary, v.p., finonciol officer	Leads & Northrup, soles monoger Sanmina, v.p. finance
Plant Genetics (PGEN) 1930 Fifth St. Davis, CA 95616 (916) 753-1400	To develop, produce, and sell plants ond plant products for the agricultural ond food industries. The compony holds o patent for a process called Gel-Coat, which encopsulates plants embryos ond other products.	$5.2 million from initiol public offering	Zachary S. Wachok, president, CEO G.P. Willsey, exec. v.p., COO Keith A. Walker, v.p. R&D	Monsanto, bus.-develap. mgr. Ferry Morse Seed, president Monsanto, sr. research group leader
Schenectady Materials and Processes Lab Box 724 Schenectody, NY 12301 (518) 382-0082	To conduct materiols analysis for occeptance testing, quolity control, and service ond product development work. Testing equipment includes o sconning electran microscope, o computer-driven image anolyzer, and o metallogroph.	Undisclosed funds from president and founders; other funds from private and government sources	Niko Gjajo, president Jocqueline Hurd, monoger, chemical onalysis	Generol Electric, manager ond chemist Generol Electric, chemicol anolyst
Surgidyne (SGDN) 9600 W. 76th St. Eden Proirie, MN 55344 (612) 941-2965	To design, develop, ond market medical ond surgical products. Its systems drain body fluids from speciol catheters, tubes, ond drains.	$1.9 million from initiol public offering	Chorles 8. McNeil, president, chairmon Arthur W. Schwalm, director Thomos G. Herschbach, director	Inmed, v.p., gen. manager Cardioc Pacemakers, president, CEO Northern Telecom, v.p.
Terodata (TDAT) 12945 Jefferson Blvd. Los Angeles, CA 90066 (213) 827-8777	To market a parollel-processing system for foult-tolerant database computer systems.	$37.5 million from initiol public offering	Jock E. Schemer, founder, choirmon Kenneth W. Simonds, president, CEO Richard L. Little, v.p., CFO	Transaction Technologies, v.p. system engineering Amdahl, exec. v.p. Quotron Systems, v.p. finance
Trig Systems 8260 West 116th St. Overland Park, KS 66210 (913) 451-5911	To provide such consulting services os strategic planning, marketing, acquisitions, divestiture, restructuring, ond long-ronge planning for the telecommunications business.	Undisclosed amount from founders	George 8enjamin, president Fronk Porsons, ossociate	Ericsson Cables, v.p., gen. monager Exxon, intl. bus. devel.—Pacific Rim
Videonics 1129 Dell Ave. Compbell, CA 95008 (408) 866-8300	To manufacture DirectED, o video-editing machine that lets VCR owners make home movies complete with titles, grophics, and special effects.	Undisclosed amount of first-round funding	Michoel L. D'Addia, president, CEO Mark C. Hahn, chief technologist Moe Rubenzohl, marketing manoger	Corvus, founder, president Corvus, founder, chief technologist Hewlett-Packard, product manager
Xscribe (XSCR) 6160 Cornerstone Court E. San Diego, CA 92121 (619) 457-5091	To design, monufacture, and morket computer-aided tronscription hardware and software for court reporting. One product, o computerized system, creates closed coptions on TV for the hearing impaired.	$9.3 million from initial public offering	Robert F. Mowhinney, chairman, CEO Thomos W. Delohanty, president, COO Malvin M. Cox, v.p. engineering	Generol Dynamics, project engineer ITT, president of various subsidiaries General Dynomics, project engineer

CONTRACTS AWARDED

AWARDED TO	AWARDED BY	AMOUNT	PURPOSE
Atlantic Research 5390 Cherokee Ave. Alexandria, VA 22312 (703) 642-4216	LTV	$3.6 million	To assist LTV's validation of an improved technology to intercept and destroy tactical missile targets.
Atlantic Research/Hercules 5390 Cherokee Ave. Alexandria, VA 22312 (703) 642-4216	Air Force—Wright Aero Propulsion Laboratory	$22.3 million	To develop and demonstrate a flight-ready, VFDR (variable-fuel-flow ducted rocket) ramjet engine.
Atlantic Research/ORI 5390 Cherokee Ave. Alexandria, VA 22312 (703) 642-4216	Naval Surface Weapons Center	$7.9 million	To provide engineering support for the Launch Control Computer Program of the Navy's vertical-launching system.
Computer Sciences 6565 Arlington Blvd. Falls Church, VA 22046 (703) 237-2000	Bendix	$22-million subcontract	To help provide operations and maintenance support to the Mission Operations and Data Systems Directorate at Goddard Space Flight Center in Greenbelt, Maryland.
Douglas Aircraft 3855 Lakewood Blvd. Long Beach, CA 90846 (213) 593-0242	U.S. Air Force, Aeronautical Systems Division	$4 million	To help design the Aircrew Training System for the C-17 transport aircraft.
Electronic Data Systems 6430 Rockledge Dr. Bethesda, MD 20817 (301) 564-3482	U.S. Navy	$544 million	To supply an automated inventory-control system to naval bases in 58 cities worldwide.
Emhart/Planning Research 1500 Planning Research Dr. McLean, VA 22102 (703) 556-1000	NASA	More than $60 million	To help automate the design and development of software for the space station program.
Grumman Aerospace A27 GHQ Bethpage, NY 11714 (516) 575-5287	U.S. Air Force, Aeronautical Systems Division, Flight Dynamics Lab	$7.5 million	To help develop a fighter aircraft capable of a high angle of attack.
Honeywell/Sperry Defense Box 9200 Albuquerque, NM 87119 (505) 828-5182	Mitsubishi Heavy Industries	$24.5 million	To develop a full-scale aerial target system for the Japanese Defense Agency.
Honeywell/Sperry Defense Box 9200 Albuquerque, NM 87119 (505) 828-5182	U.S. Army Missile Command	Not disclosed	To design and develop the control system for an unmanned-drone version of the Sikorsky S-55 helicopter.
Informa 108 Wild Basin Rd. Austin, TX 78746 (800) 227-6412	Texas Department of Human Services	$12 million	To supply equipment and software for a 3,200-workstation, 166-server network that will eventually link the department's local offices.
Lockheed Missiles & Space Org. 24-01, Bldg. 101 Sunnyvale, CA 94086 (408) 742-6688	Air Force Systems Command (Norton AFB)	$2.5 million	To develop operational prototype designs for an earth-penetrating, maneuvering re-entry vehicle for intercontinental ballistic missiles.
Lockheed Missiles & Space Org. 24-01, Bldg. 101 Sunnyvale, CA 94086 (408) 742-6688	NASA	$141 million	To automate the design and development of software for the space station.

AWARDED TO	AWARDED BY	AMOUNT	PURPOSE
Lorol Electra-Optical Systems 600 Third Ave. New York, NY 10016 (212) 697-1105	First contract: Fairchild Industries Second contract: U.S. Air Force	$9 million	To make o space-based imoging system for detecting intercontinentol ballistic missiles. A second contract calls for development of spacecroft power-conversion systems.
Martin Marietta 103 Chesopeake Park Plazo Baltimare, MO 21220 (301) 682-111S	Deportment of Energy, Sandia National Lobaratories	$2.6 millian	To conduct initiol development of o robot equipped with onti-armor missiles ond remote-controlled by a fiber-optic link, for the U.S. Army Missile Command.
Quantex 2 Research Ct. Rockville, MD 208S0 (301) 258-2701	U.S. Department of Defense	Four cantrocts totolling $200,000	To study high-speed, opticol dato ocquisition; solid-state photography; wide-spectral-band detectors; and electron-trapping materiols.
Rockwell/Autonetics Electronics 3370 Miralomo Ave. Anaheim, CA 92803 (714) 762-419S	U.S. Air Force	$16S million	To provide guidance and control systems for the Peacekeeper intercontinentol ballistic missile.
Singer/Link Flight Simulation Corporate Dr., M.S. 244 Binghamton, NY 13902 (607) 772-3127	U.S. Air Force, Aeronautical Systems Division	$4.9 million	To help design the Aircrew Training System for the C-17 tronsport aircraft.
TRW, Electronics & Defense 1 Spoce Park Redondo, CA 90278 (213) S3S-4170	U.S. Air Force	$743.S million	To build and lounch five early worning sotellites to detect long-ronge missile attocks.
TRW, Electronics & Defense 1 Spoce Park Redondo, CA 90278 (213) S3S-4170	U.S. Air Force	$33.6 million	To work on a spoce surveillance and tracking system.
United Airlines Services 3609 S. Wadsworth Blvd. Lakewood, CO 8023S (303) 986-0S21	U.S. Air Farce, Aeronautical Systems Division	$2.9 million	To help design the Aircrew Training System for the C-17 tronsport aircraft.

MERGERS

COMPANY	BUSINESS	COMPANY	BUSINESS	NEW NAME
Advanced Micro Devices 901 Thompson Place Sunnyvale, CA 94086 (408) 732-2400	Semiconductors	Monolithic Memories 217S Mission College Blvd. Sonta Clara, CA 9S0S4 (408) 970-9700	Semiconductors	Monolithic becomes o wholly owned subsidiory of AMD but retains its nome
Liuski International 9-02 43rd Rd. Long Island City, NY 11101 (718) 706-7770	Computer distributar	Magtron Technology 1017 E. Alosto Ave. Glendoro, CA 91740 (818) 914-4783	Computer distributor	Liuski Internotionol East/West
SafeCard Services 6400 N.W. 6th Way Fort Lauderdale, FL 33309 (30S) 491-2111	Subscription-service soles	CCC Information Services 640 N. LaSalle St. Chicago, IL 60610 (312) 787-2640	Computerized-data services ond claims management for car-insuronce companies	CCC becomes a wholly owned subsidiary of SofeCord but retains its name
Woste Management 3003 Butterfield Rd. Oak Brook, IL 60S21 (312) S72-8800	Waste manogement	Modulaire Industries 744 Montgomery St. San Francisco, CA 94111 (41S) 433-2323	Soles, rentals, ond servicing of mobile offices	Modulaire becomes a wholly owned subsidiary af Waste Management but retoins its nome
Xtal 12217 Nicollet Ave. Minneapolis, MN SS337 (612) 894-9010	Factory-outomation systems	Mfg. Data Exchange 7644 W. 78th St. Minneapolis, MN SS43S (612) 829-7022	Factory-automation systems	Xtol

ACQUISITIONS

BUYER	BUSINESS	COMPANY ACQUIRED	BUSINESS	AMOUNT
American Cimflex 160 Industry Dr. Pittsburgh, PA 15275 (412) 787-3000	Computer-integrated-manufacturing products and systems	Central Automation Box 2304 Princeton, NJ 08540 (609) 799-7690	Vision-inspection systems	Not disclosed
Applied Intelligent Systems 110 Parkland Plaza Ann Arbor, MI 48103 (313) 995-2035	Parallel processors for machine-vision systems	VSP 110 Parkland Plaza Ann Arbor, MI 48103 (313) 995-2035	Video-camera systems	Not disclosed
Atlantic Research 5390 Cherokee Ave. Alexandria, VA 22312 (703) 642-4000	Advanced technology, including rocket motors, communications systems, and computers	Amercom 8928 Fullbright Ave. Chatsworth, CA 91311 (818) 882-4821	Advanced high-temperature materials	$3 million
Davox 4 Federal St. Billerica, MA 01821 (617) 667-4455	Computer-aided communications systems	TBS International 959 E. Collins Richardson, TX 75081 (214) 690-9436	Automatic-dialing systems	$12.3 million
FiberNet Communications 319 Lake Ave. Metuchen, NJ 08840 (201) 494-9000	Long-distance telephone service	Telephone Systems Box 22034 Pittsburg, PA 15222 (412) 391-2910	Long-distance telephone service	Not disclosed
Litton 303 E. Wacker Dr. Chicago, IL 60601 (312) 664-4558	Electronic and defense systems	Integrated Automation 1301 Harbor Bay Pkwy. Alameda, CA 94501 (415) 769-5400	System integration	Not disclosed
McGinley Cable Box 550 Skippack, PA 19474 (215) 584-9595	Telecommunications	Star Datacom Box 550 Skippack, PA 19474 (215) 584-9595	Telecommunications	Not disclosed
MECA Ventures 355 Riverside Ave. Westport, CT 06880 (203) 222-1000	Software	MECA 285 Riverside Ave. Westport, CT 06880 (203) 222-1000	Software	Not disclosed
Micratel 7100 W. Camino Real Boca Raton, FL 33433 (305) 392-2244	Long-distance telephone service	Suncoast Communications 1670 Main St. Sarasota, FL 63578 (813) 955-9533	Long-distance telephone service	Not disclosed
National Semiconductor 2900 Semiconductor Dr. Santa Clara, CA 95051 (408) 721-5000	Semiconductors	Fairchild Semiconductor 277 Park Ave. New York, NY 10072 (212) 350-9503	Semiconductors	$122 million
Science Accessories 970 Kings Highway W. Southport, CT 06490 (203) 255-1526	Manufactures sonic digitizers	Owl Electronics Laboratories 22 Pequot Park Rd. Westbrook, CT 06498 (203) 399-5951	Design engineering and manufacturing	Not disclosed
SmithKline Beckman Box 7929 Philadelphia, PA 19101 (215) 751-4000	Eye- and skin-care products	International Hydron 185 Crossways Park Dr. Woodbury, NY 11797 (516) 364-1700	Contact lenses	$155 million
Teradyne 321 Harrison Ave. Boston, MA 02118 (617) 482-2700	Automatic test equipment and software	Zehntel 2625 Shadelands Dr. Walnut Creek, CA 94598 (415) 932-6900	Circuit-testing equipment and workstations	$75 million

THE HIGH TECHNOLOGY BUSINESS LEADING 100

COMPANY (SYMBOL)	PRICE INCREASE LAST MONTH (%)	CLOSING PRICE ($)	PREVIOUS MONTH'S RANK	EARNINGS PER SHARE		LATEST DIVIDEND ($)	P/E RATIO	DEBT/ EQUITY RATIO	LATEST 12 MONTHS' REVENUE (IN MILLIONS)
				LAST QUARTER ($)	CHANGE FROM 1 YEAR AGO				
AEROSPACE									
Sierracin (SER)	22.2	8.25	*	.24	60.0	.00	NE	.38	74.3
OEA (OEA)	16.4	28.38	4	.42	.0	.00	17.6	.00	41.5
Gull (GLL)	13.1	18.25	*	.38	NE	.05	16.9	1.05	72.9
ARX (ARX)	7.2	11.13	5	.40	48.1	.00	11.1	.84	60.6
Sequo (SQAA)	6.0	84.00	8	1.53	-30.1	.60	4.2	.43	525.7
Hexcel (HXL)	5.2	53.38	7	.75	23.0	.60	22.1	.87	319.7
Langley (LCOR)	4.1	9.50	1	.20	-4.8	.45	17.3	.00	12.2
Foirchild Ind. (FEN)	3.8	13.63	*	.59	NE	.20	NE	4.49	628.3
Watkins Johnson (WJ)	2.6	34.38	*	.45	-16.7	.40	17.9	.26	256.2
Curtiss-Wright (CW)	2.0	64.25	*	1.47	48.5	1.60	12.6	.24	180.1
CHEMICALS									
Vista Chem. (VC)	19.0	47.00	7	.83	93.0	.05	20.0	3.56	582.2
Georgia Gulf (GGLF)	14.2	59.38	1	1.25	123.2	.20	18.3	1.07	620.1
W-0 Forty (WDFC)	9.2	35.50	*	.30	-25.0	1.32	24.0	.00	71.2
Free Mc. Rsc. (FRP)	5.9	20.25	*	NA	NA	2.40	NA	NA	NA
Imperial Chem. (ICI)	5.8	100.75	*	1.98	30.3	3.11	6.8	.44	17,331.7
Stepan (SCL)	5.7	48.75	*	.94	44.6	.80	16.1	.63	274.4
Huntington Intl. (HRCLY)	5.4	24.25	*	.31	47.6	.00	23.5	.27	63.5
Oow Chemicol (DOW)	3.7	96.88	10	1.64	37.8	2.20	20.7	.66	11,957.0
Publicker Ind. (PUL)	3.7	3.63	5	-.06	-100.0	.00	NE	1.95	13.1
Ausimont (AUS)	3.6	21.50	8	.49	19.5	.32	12.1	.25	728.0
COMMUNICATIONS									
Inter. Tel. (INTLA)	83.8	7.13	*	.02	100.0	.00	89.1	.37	39.6
ALC Camm. (ALCC)	33.1	3.50	*	NC	NC	.00	NE	2.39	NC
Comcoa (CCOA)	26.7	11.25	*	-.02	NE	.00	NE	2.26	9.7
Intl. Mobile Mach. (IMMC)	14.8	14.50	*	-.15	NE	.00	NE	.01	1.7
Adv. Telecom. (ATEL)	12.1	27.75	*	.28	100.0	.00	27.5	.26	78.7
Telephone Data (TOS)	10.8	37.13	2	.26	-53.6	.54	31.7	2.01	169.1
Acton (ATN)	8.5	20.88	4	3.65	NE	.00	NE	2.18	25.8
AIM Telephone (AIMT)	8.1	10.00	*	.08	60.0	.00	33.3	.77	27.5
ADC Telecomm (AOCT)	7.9	27.25	*	.53	47.2	.00	17.6	.06	158.9
CTEC (CTEX)	6.3	34.00	*	.60	50.0	.92	16.8	1.33	131.6
COMPUTERS									
Fronklin Computer (FOOS)	52.0	9.50	1	-.11	NE	.00	NE	.47	27.5
Primages (PRIMC)	45.2	3.63	*	.02	NE	.00	NE	2.22	5.3
Comp. Identics (CIDN)	33.D	2.5D	2	-.15	NE	.00	NE	.00	11.1
Iverson Tech (IVTC)	31.9	22.75	*	.15	.0	.00	36.1	1.14	25.6
Appld. Dato Comm. (AOCC)	26.7	4.75	*	-.13	NE	.00	NE	.00	5.9
Vermont Research (VRE)	25.9	9.13	*	-.51	NE	.00	NE	.00	5.2
Alloy Computer (ALOY)	23.1	12.00	*	.18	200.0	.00	20.0	.00	44.6
C 3 (CEE)	22.9	14.13	*	.23	360.0	.00	23.2	.00	90.5
Micro 0 (MCRD)	20.8	12.38	*	.16	166.7	.00	20.0	.00	290.6
Datapoint (OPT)	20.4	8.13	*	.06	500.0	.00	NE	.42	312.1
DRUG MANUFACTURERS									
IGI (IGEN)	235.5	20.13	1	.03	200.0	.00	NM	.64	18.0
8olar Pharm. (BLR)	76.6	51.00	10	.23	35.3	.05	44.7	.00	61.9
Viratek (VIRA)	56.8	29.00	3	-.34	NE	.00	NE	.00	7.4
VLI (VLIS)	48.5	6.31	*	-.02	NE	.00	NE	.00	18.9
Cooper Devel. (8UGS)	30.8	13.25	*	-1.40	NE	.00	NE	5.37	371.4
University Genetic (UGEN)	30.6	1.88	*	-.02	NE	.00	NE	.05	3.9
Nature's Sunshine (AMTC)	26.0	10.75	4	.26	116.7	.00	14.7	.08	34.6
Summa Medicol (SUMA)	25.1	2.19	*	-.35	NE	.00	NE	.72	3.7
Lyphomed (LMED)	24.0	29.75	*	.17	30.8	.00	48.0	.04	149.3
Centocor (CNTO)	22.0	39.50	*	.49	276.9	.00	NE	.06	34.9

The following are the 10 companies in each of 10 industries that had the highest stock gain over the previous month (figures as of 9/9/87).

NE = Negative earnings NC = Not calculable NM = No meaningful figure * = Not among Leading 100 last month

COMPANY (SYMBOL)	PRICE INCREASE LAST MONTH (%)	CLOSING PRICE ($)	PREVIOUS MONTH'S RANK	EARNINGS PER SHARE		LATEST DIVIDEND ($)	P/E RATIO	DEBT/ EQUITY RATIO	LATEST 12 MONTHS' REVENUE (IN MILLIONS)
				LAST QUARTER ($)	CHANGE FROM 1 YEAR AGO				
ELECTRONICS									
Rond Info. Syst. (RINSE)	44.2	1.63	2	-.33	-100.0	.00	NE	1.64	7.5
Gentex (GNTX)	43.2	6.00	5	.06	20.0	.00	28.6	.05	14.5
Kevlin Micro (KVLM)	36.4	3.75	*	.03	200.0	.00	NM	.02	5.9
Termiflex (TFLX)	33.3	6.00	*	.03	-70.0	.00	22.2	.00	5.6
Plexus (PLXS)	31.8	7.25	*	-.09	-100.0	.00	NE	.68	17.2
Technic. Commun. (TCCO)	30.8	4.25	*	-.02	NE	.00	NE	.00	3.5
Electro Sci. (ESIO)	28.6	11.25	*	-.43	-100.0	.00	NE	.12	57.7
Repco (RPCO)	28.3	5.13	*	.02	100.0	.00	NM	.82	17.6
Tekelec (TKLC)	27.8	5.75	*	-.04	-100.0	.00	33.8	.01	15.1
IEC Electronics (IECE)	25.1	8.13	*	.15	200.0	.10	14.8	.15	21.5
HEALTH									
Delmed (OMO)	79.8	1.69	*	-.01	NE	.00	NE	55.25	26.3
Novo Pharm. (NOVX)	28.2	15.38	*	-.12	NE	.00	NE	.01	4.9
Prof. Care (PCE)	25.0	1.25	*	-.20	-100.0	.00	NE	.44	48.6
Temco Home Health (TEMC)	23.6	3.25	*	.05	400.0	.00	27.1	.00	13.3
Intl. Hydron (HYD)	22.6	9.50	*	.13	85.7	.00	21.6	.94	75.0
Minntech (MNTX)	20.3	11.13	*	-.17	-100.0	.00	NM	.13	11.1
Morquest Med. (MMPI)	13.8	12.38	10	.20	150.0	.07	NE	.98	39.6
Utd. Industrial (UIC)	13.4	18.00	*	.22	-21.4	.64	NE	.15	280.2
Life Sciences (LFSC)	13.0	1.56	*	-.03	NE	.00	NE	.25	.9
Cordis (CORD)	11.2	16.13	*	-4.01	NE	.00	NE	.54	107.1
METALS FABRICATION									
Synalloy (SYO)	17.1	5.13	*	-.07	-100.0	.00	NE	.20	47.5
Steel Technologies (STTX)	9.7	28.25	*	.15	-31.8	.02	29.1	.12	78.9
RB&W (RBW)	7.7	7.00	*	.11	-26.7	.10	28.0	.81	163.1
Elco Inds. (ELCN)	6.7	24.00	*	.68	70.0	.88	14.0	.47	128.0
Pitt DesMoines (POM)	5.1	23.00	*	.13	NE	.00	NE	.32	240.4
Graham (GHM)	4.5	8.88	*	-.24	NE	.00	10.4	.76	46.0
Columbio Genl. (CLGN)	4.0	6.50	*	.27	800.0	.00	7.8	.62	61.6
MLX (MLXX)	1.7	7.00	*	.09	350.0	.00	NE	6.36	252.0
Moog (MOGA)	1.5	17.13	*	.31	19.2	.28	16.5	.99	312.1
Am. Locker (ALGI)	1.0	12.50	*	.24	-27.3	.28	11.7	.03	26.4
SCIENTIFIC AND ELECTRONIC INSTRUMENTS									
Intl. Remote Ima. (IRIS)	21.9	2.06	*	-.02	NE	.00	NE	.00	4.3
Oetector Elctr. (OETX)	20.0	6.00	*	.02	NE	.00	NE	.25	16.6
Oiognostic Ret. (ORSA)	18.6	13.50	*	.13	85.7	.00	20.1	.92	57.8
Austron (ATRN)	15.2	2.88	*	.07	NE	.00	28.8	.23	8.1
Bowmar Instr. (BOM)	15.2	2.88	*	-.09	-100.0	.00	NE	1.13	53.5
Sym Tek Systems (SYMK)	14.8	15.50	*	-.30	-100.0	.00	NE	.07	23.1
Kulicke & Soffa (KLIC)	14.2	15.00	*	-.27	NE	.00	NE	.89	65.1
Environ. Tectonics (ENVT)	13.6	6.25	6	.03	-25.0	.00	NM	.15	12.5
Resource Eng. (RSE)	10.7	16.88	*	.10	66.7	.00	51.1	2.05	42.2
Loser Precision (LASR)	10.5	6.50	*	.02	.0	.00	28.3	.01	16.9
SOFTWARE AND DATA PROCESSING									
Endato (DATA)	48.0	13.88	*	.14	27.3	.10	25.7	.38	39.8
Dicomed (OCOM)	46.3	2.56	*	-.47	NE	.00	NE	.38	20.6
Scitex Ltd. (SCIXF)	33.1	3.50	*	-.23	NE	.00	NE	.26	150.6
Group 1 Software (GSOF)	28.2	11.38	*	.14	40.0	.00	25.9	.00	9.2
Wilond Services (WSVS)	25.3	1.88	*	-.03	-100.0	.00	NE	1.35	15.1
Epsilan Data Mgmt. (EPSI)	21.6	11.25	*	-.04	NE	.00	NM	.22	47.2
Scicom Oata (SCIE)	18.0	9.00	*	.25	78.6	.00	10.7	.97	14.5
MocNeal Sch. (MNS)	16.9	19.88	*	.18	38.5	.20	30.6	.04	30.7
Digilog (DILO)	16.4	8.88	*	.14	75.0	.00	15.6	.39	17.6
Oato Arch (OAI)	16.1	12.63	*	.19	26.7	.00	17.3	.02	30.9

SOURCE: MEDIA GENERAL FINANCIAL SERVICES

JOINT VENTURES

COMPANY	COMPANY	PURPOSE	CONTACT
Austria, Alitalia, British Airways, KLM	British Caledonian, Swissair, United Air's Cavia	To automate airline travel-reservation and information systems, under the name Galilea Distribution Systems.	Cavio 9700 W. Higgins Rd. Rosemont, Il 60018 (312) 318-4000
Microsoft	Altas Computer Systems	To develop versions of the Unix operating system.	Microsoft 16011 N.E. 36th Way Redmond, WA 98073 (206) 882-8080
Nippon Telegraph & Telephane	Battelle Memorial Institute and Mitsubishi	To develop opticol integrated-circuit technology for commercial use, under the nome Photonic Integration Research.	Photonic Integration 13S7 Perry St. Columbus, OH 43201 (614) 424-3200
SmithKline Beckmon	Sumitomo Pharmaceuticals	To develop and market nonprescription drugs and other consumer products in Japan, under the name SmithKline Sumiyoku Pharmaceuticals.	SmithKline Sumiyoku 6 Sambancho Tokyo 102, Japan (81) 3-221-S811
US West	Microsoft	To develop an information-industry application based on CD-ROM technology.	US West 6200 S. Quebec St. Englewood, CO 80111 (303) 740-4428

RESEARCH REPORTS

STUDY BY	TITLE	FORECAST	PRICE
Frost & Sullivan 106 Fulton St. New York, NY 10038 (212) 233-1080	Computer Room Enviranment Equipment in the EEC (#E931)	The morket for ancillary computer-room equipment will increase 90% between 1985 and 1991; access-control gear, by 106%. Morket will top $330.1 million by 1990.	$2,4S0
Frast & Sullivan 106 Fultan Street New York, NY 10038 (212) 233-1080	Database-Monogement-System Morket (#A1728)	Software to monage databases will multiply fivefold by 1991, moking it a $10 billion/year morket for U.S. producers.	$1,925
Market Intelligence Research 2S2S Charleston Rd. Mountoin View, CA 94043 (415) 961-9000	World Signal-Generator Morkets (#A087)	The $362-million 1987 morket for signal generators will reach $777.S million by 1993.	$99S
Morket Intelligence Research 252S Chorleston Rd. Mountain View, CA 94043 (415) 961-9000	Distribution Channels for Telecommunications Products (#A091)	End-user demand for connectivity will benefit the regionol holding companies ot the expense of the interconnects.	$99S
Morket Intelligence Research 2S2S Charleston Rd. Mountain View, CA 94043 (41S) 961-9000	Electrical vs. Opticol-Fiber Medio: Focus on Locol-Area Networks (#A107)	Broodband networks will experience the highest growth rates in network shipments, instolled base, and dollar volue from 1986 to 1988.	$99S
Technology Financial Services 4 Courthouse Lone Chelmsford, MA 01824 (617) 4S8-3974	Loser Printer Service Opportunities ond Ployers	1987 revenues for non-impact poge printers will exceed $2 billion, opening a lorge morket for service as worranties expire.	$49S ($S9S after Nov. 1S)
Technology Management Group 2S Science Pork New Hoven, CT 06S11 (203) 786-S44S	The Impact of Biotechnology on Plant Agriculture	By 1990, o variety of companies will introduce plont ogriculturol products developed by advanced biologicol techniques, creating major morket opportunities.	$2,9S0

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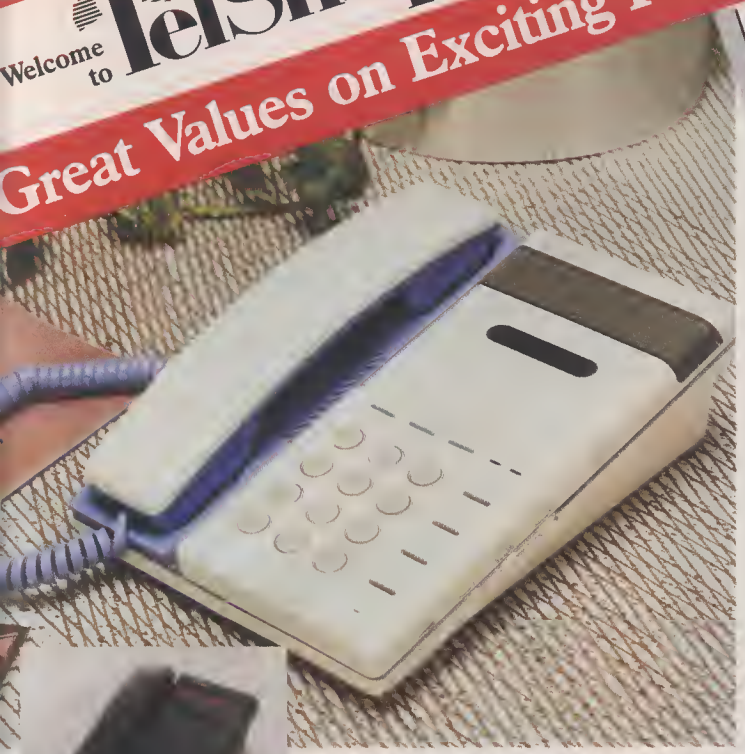

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A. Sharp's new line of combination telephone and answering systems (model no. FP700) will make it seem like there's a receptionist in your home. Advanced features include IC recording chip, which makes for improved voice reproduction and eliminates the need for a second microcassette tape, thus clearing out space for more convenience features. And the list is long, including local message memo, on-line conversation record, call screening and select call. Sharp has designed this advanced machine for ease of operation, with beeperless remote, 12 auto dial memory and pulse/tone switchable. Available in blue/white or black.
6 5/16"W × 3 15/16"H × 8 11/16"D.

A.

RT001 Retail 239.95
Telshop price 149.95 (4.95)
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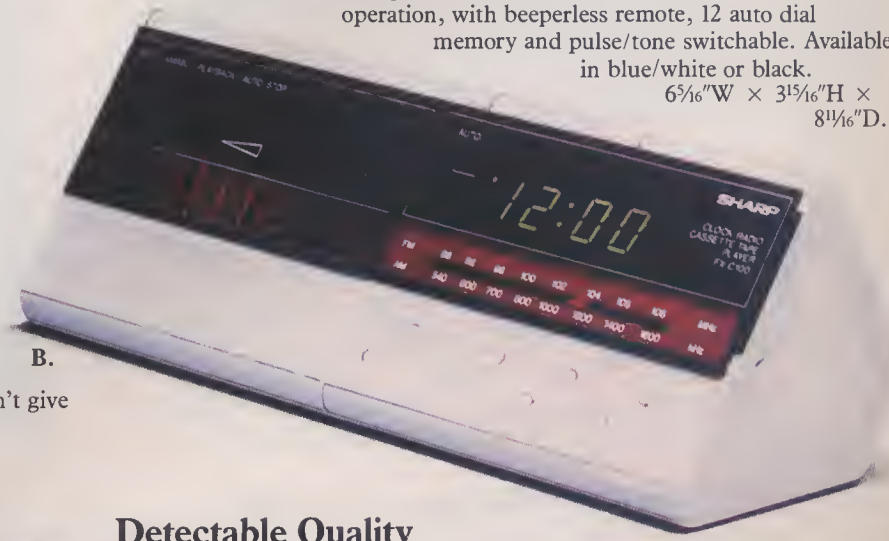
Wake up to Great value

B. Radio, cassette tape or buzzer—three ways to start a new day are all at your fingertips with Sharp's new AM/FM digital clock radio (model no. FXC100) with cassette player and auto stop. Large, easy to read green LED display tells you the time from virtually any angle, while battery back up ensures uninterrupted operation. Best of all, the unit comes with a 59-minute sleep timer for those who just can't give up the mattress! 9 11/16W" × 4 1/8"H × 4 3/4"D.
RT002 Retail 64.95
Telshop price 49.95 (4.75) **Save 15.00**



B.

Detectable Quality

C. Make tracks but do so discreetly with Rally's super compact radar detector (model no. XK500). About the width of your key chain, this radar detector comes standard with features normally found in much higher end units. The heart of the unit is the dual conversion X & K bands superheterodyne technology, which gives you complete cover from both of the frequencies police transmit on to snare speeders. Other features include LED signal strength meter, city/highway switch, variable volume control and dash visor mounting bracket. All at a s-low, s-low price!
3 1/4"W × 7/8"H × 4 3/4"D.
RT003 Retail 119.95
Telshop price 69.95 (3.95)
Save 50.00

C.

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Complete Entertainment Center

A.

A Sound Viewing Experience

A. Sharp's new 140-channel cable capable 20-inch Super VHS compatible monitor/TV (model no. 20MV97) set is absolutely state of the art. Flat, square, tinted picture tube is capable of up to 400 lines of horizontal resolution when used with Super VHS. By contrast, regular TV broadcasts at 320 lines while the average VCR tunes in at a mere 270 lines. You'll be wondering how such exhilarating audio and clear, bright images can come out of such a compact unit. The answer: a built-in MTS (multi-channel TV sound) stereo decoder and two-way two-speaker stereo. But that's not all you get for this great price, because the 26-function solar powered infrared remote needs no batteries. And, on screen display indicates channel, time of day, volume and minutes remaining on sleep timer. Includes A/V jacks for easy computer hookup. 23 15/32"W × 22 43/64"H × 22 1/4"D.
RT004 Retail 799.00
Telshop Price 549.00 (20.95)
Save 250.00

Well-Done Rack of Sound

C. Sharp has delivered the best affordable sound system (model no. Z1000-DX) on the market today. The heart of the system is a **monster receiver** that puts out 120-watt minimum per channel into 8 ohms from 40 Hz to 20,000 Hz with no more than 0.5% total harmonic distortion. The receiver includes 7-band graphic equalizer *and* 7-band spectrum analyzer to permit precise calibraton of the sound to the listener's sonic tastes and to individual room acoustics. A **compact disc player** with 20 random access programming and 3-beam laser pick-up produces crisp, clear sound, while a **digital synthesized tuner** with 14 station presets and auto scan finds the station for you and then locks it in. Rounding out the system are a semi-automatic belt driven **turntable** and **dual cassette deck** with high speed dubbing continuous playback and DOLBY noise reduction. And topping it all off are a **pair of speakers** that will surely bring music to your ears. A specially developed three-way system, each speaker contains a 5-inch midrange and dome type tweeter, **anchored by a 10-inch down firing super woofer** that disperses rich, powerful bass evenly to all parts of the listening room. A package hard to beat at twice the price!
Rack 20 1/8"W × 40 5/8"H × 16 9/16"D. Speakers 13 7/16"W × 41"H × 13 7/16"D.
RT006 Retail 1349.95 Telshop Price 995.00 ($75 truck) **Save 354.95**

C.

Picture Perfect Video Cassette Recorder

E. Do you often wish you could view several channels at once? Your wish has been granted by Sharp's new 110 channel cable ready digital special effects two-head VCR (model no. VCD800U) with its 9 picture on screen and channel search with picture in picture. VHS HQ circuitry with double comb filter ensures vivid, razor sharp picture. Standard equipment also includes TV strobe slow motion playback and still function for matchless slow motion and freeze frame; random access tuner for instant channel switching; 14-day, two-event programming; 35-function wireless remote and two-speed video search. And Sharp has included some nice little extras: on screen timer programming display and blue screen noise elimination system. 17"W × 4"H × 13 3/4D.

RT008 Retail 499.00
Telshop Price 399.00 (11.95)
Save 100.00

E.

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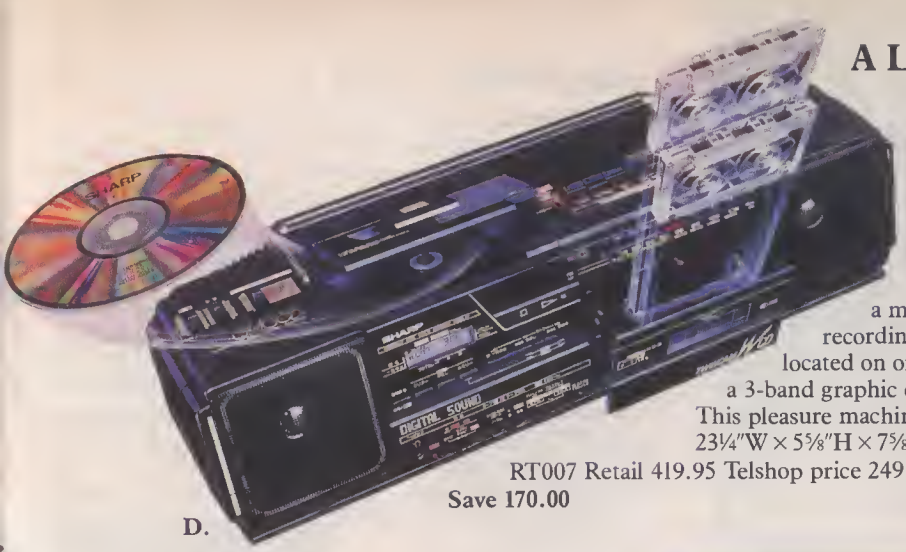
A Little Travelin' Music



D.

D. Compact-disk quality sound to go is now a reality with Sharp's new feather-like 12 pound totable unit (model no. WQCD30). But you're not limited to CDs only, because Sharp added twin cassette decks with continuous playback from tape one to tape two, as well as high speed dubbing. The side-to-side placement of the cassette decks has twin benefits. One, it allows for a much smaller unit and two, it reduces distortion when recording from one tape to another since all heads are located on one capstan. Rounding out a great sound package are a 3-band graphic equalizer and a super sensitive AM-FM stereo radio. This pleasure machine would make a superb gift to give—and to receive! 23¼"W × 5⅝"H × 7⅝"D.

RT007 Retail 419.95 Telshop price 249.95 (5.95)
Save 170.00

User-Friendly Camcorder

F.

F. Ease of operation and up-to-the-minute technology converge in Sharp's new miniature camcorder (model no. VLC73UA). Sharp wanted to design a camcorder that would be simple enough to be used with great results by novices, yet with enough professional quality options to meet the needs of video mavens. Mission accomplished. Most important, easy-to-use ½-inch VHS-C cassettes are fully compatible with VHS recorders once tape is placed in an adaptor included with the unit. Video sophisticates will warm to the high speed electronic shutter with 1/1000th second shutter speed, variable 8x power zoom lens, sound track mixing, HQ system quality plus CCD image sensors and full auto white balance, auto iris, auto date and auto power off. Neophytes will enjoy the automatic focus, which allows the user to simply aim and shoot. Everybody will relish the super-SHARP images. 5 lbs.

RT009 Retail 1599.00
Telshop price 1199.00 (5.95) **Save 400.00**

Performance Video on a Shoestring

B. You probably thought a performance-oriented VCR at a reasonable price was thoroughly impossible? It was—until Akai developed this new model (model no. VS-M910-UB), which, in critical ways, is identical to Akai's costliest units. DX4 four head double azimuth system with HQ circuitry provides highest quality reproduction and super-sharp analog special effects, and is programmable for six broadcasts over two weeks. Other standard features include VHS "HI-FI" with MTS stereo, 167 channel cable ready tuner; the world's first VHS quick start system with index and address search; super clear slow motion, still frame and frame advance. And for those who like to see the results of their efforts, Akai designed this super sophisticated unit with on-screen programming. Now, setting the channel and timer's problem free! 15.2"W × 3.6"H × 14.3"D.

RT005 Retail 749.00
Telshop price 599.00 (11.95) **Save 150.00**

B.

CALL TOLL FREE
1-800-962-2962

A.

Packard-Bell 1, IBM 0

A. Packard-Bell's powerful, full featured personal computer (model no. VX88F/1420) is IBM PC XT compatible, but that's where the similarities end. The VX-88 leaves Big Blue in the dust, in speed, memory, economy, performance and size. Unit comes complete with color monitor, built in color graphics, a 360K floppy disk drive, and 64OK of RAM memory, a 20 Mb hard disk drive, GW basic and AT style keyboard. And it operates at either 5.5 or 8 MHz, compared with the XT's 4.77 MHz. You'll appreciate its 14.45-inch width—a full five inches less than the IBM. But that's still not all. Large 14 inch RGB color graphics monitor with .43 dot pitch is easy on the eyes and makes any type of computer operation, from word processing to games playing, a pleasurable experience.
RT010 Retail 2198.00
Telshop price 1395.00 (19.95)
Save 803.00

B.

It's a Clean Machine

B. Say goodbye to computer and office equipment down time caused by dust, staples, and other intruders that can creep in and damage the works. Data-Vac (model no. MDV-1), the first hand-held, high powered electric vacuum/blower system designed exclusively for computers and office equipment, is used by government services and field maintenance technicians. Data-Vac comes complete with crevice tool, air "pin pointer," finishing soft bristle brush, easy carry shoulder strap and five standard disposable paper bags. Lightweight all-steel vacuum blower power unit runs on 1.73 amps and has a hefty 200 watts of suction power. Flexible 19-inch hose will ensure that no speck goes undetected! 16" length.
RT011 Retail 87.00 Telshop price 49.95 (5.95) **Save 37.05**

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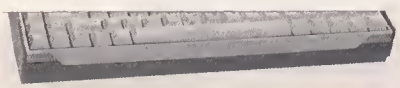

M15 laptop computer. Stores 512 kilobytes of memory and has two 3½-inch disk drives, liquid-crystal display, and detachable keyboard. RS-232C and Centronics parallel interfaces connect to modems and printers. $1,995. Olivetti USA, Office Products Div., 765 Highway 202, Somervile, NJ 08876. (201) 526-8200. *Circle 1.*

1400 LT laptop computer. An MS-DOS-compatible computer with a backlit liquid-crystal display, two 3½-inch disk drives, a 768-kilobyte memory, and a 76-key keyboard. Runs off a rechargeable battery. $1,599. Tandy/Radio Shack, 1800 Tandy Center, Fort Worth, TX 76102. (817) 390-3549. *Circle 2.*

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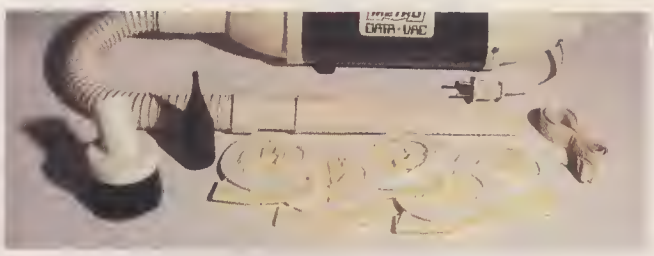

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The Latest Laptop Computers

OFFICE PRODUCTS

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Instant Yellow Page database. Lets any personal computer or terminal with a modem access every Yellow Page directory in the United States. Options include zip-code, county, and professional-specialty selection. $1.00/minute, plus 10 cents for each name printed or displayed. First-year subscription, $95; $60 to renew. American Business Lists Inc., 5707 S. 86th Circle, Omaha, NE 68127. (402) 593-4593. *Circle 6.*

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PG 108 laser printer. Produces eight pages/minute and offers 512 kilobytes of memory, expandable to four megabytes, and liquid-crystal display menu. Prints 16 fonts on one page and emulates Hewlett-Packard's LaserJet Plus. $2,595. Olivetti USA,, 765 Highway 202, Somerville, NJ 08876. (201) 526-8405. *Circle 12.*

PS/2 Models 25 and 80. These computers work twice as fast as the IBM PC. They run DOS Version 3.3, use 3½-inch disks, and offer multicolor graphics, a pointing device, and keyboard ports. Model 25 is available as a Collegiate version with 128 kilobytes of memory and an optional second disk drive. Model 80 has a 314-megabyte fixed disk, expandable to 628 megabytes, and seven expansion slots. $1,695 for Model 25, $314 for the Collegiate version, $13,995 for Model 80. IBM, Informations Systems Group, 900 King St., Rye Brook, NY 10573. *Circle 13.*

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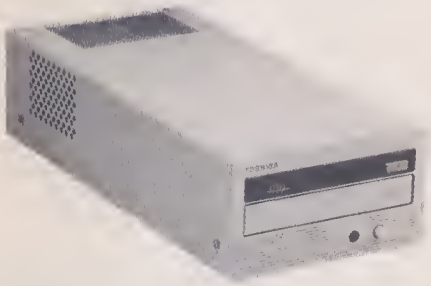
ViceVersa conversion software. Lets a Xerox Memorywriter exchange documents with such word-processing programs as WordPerfect, MultiMate, DisplayWrite, WordStar, and Samna Word running on a personal computer. The conversion process preserves such document formats as margins and tabs. $249.95. Information Conversion Services, Inc., 1625 S. Fairview, Park Ridge, IL 60068. (312) 266-8378. *Circle 18.*

COMPUTER HARDWARE



XM-2100 optical-disk drive. Lets users take advantage of MS-DOS CD-ROM storage devices. The drive has audio and digital capability and stores as much as 680 megabytes. From $525 each in lots of 1,000. Toshiba America, Disk Products Div., 9740 Irvine Blvd., Irvine, CA 92718. (714) 583-3108. *Circle 19.*

402-A video-display terminal. Displays one- or two-inch characters in color on a 25-inch screen. Characters may be green, red, or light brown. $3,450. Demex Inc., Box 1123, Shawnee Mission, KS 66222. (913) 829-3636. *Circle 20.*

AAX and DMS voice-mail options. One option increases capacity on the company's Automated Attendant Exchange (AAX) voice-mail system; the other is a smaller version of the Dytel Message System (DMS), which supports four ports and costs less than $10,000 (the DMS normally supports eight ports to serve 500 people). The AAX costs $10,000 to $40,000. Dytel, 50 E. Commerce Dr., Schaumburg, IL 60173. (312) 519-9850. *Circle 21.*

AJ 9601-STF modem. For point-to-point or multipoint transmissions. Provides duplex, synchronous operation at 9,600 bits/second over 4-wire, unconditioned leased lines. $1,695. Anderson Jacobson, 521 Charcot Ave., San Jose, CA 95131. (800) 423-6035. *Circle 22.*

Bigmouth digital recording system. Working with the IBM PC/XT/AT and compatible computers, this system handles the telephone, including answering, message taking, automatic dialing, call screening, voice mail. It also creates an activity log and connects to alarm systems. $239. Talking Technology Inc., 6558 Lucas Ave., #301, Oakland, CA 94611. (415) 339-8225. *Circle 23.*

CM-1420 color monitor. A 14-inch screen suited for high-resolution color graphics. $2,245; $2,395 on a tilt-and-swivel stand. Seiko Instruments USA, Graphic Devices and Systems Div., 1130 Ringwood Court, San Jose, CA 95131. (408) 943-9100. *Circle 24.*

Domain 4000 workstation. This desktop workstation handles four million instructions/second and displays 256 colors. A monochrome version costs less than $14,000; the color model, less than $19,000. Apollo Computer Inc., 330 Billerica Rd., Chelmsford, MA 01824. (617) 256-6600. *Circle 25.*

Edapt external-disk-drive interface. Lets PS/2 users access 3½-, 5¼, or 8-inch disks from existing drives. $99. Flagstaff Engineering, 1120 Kaibab Lane, Flagstaff, AZ 86001. (602) 779-3341. *Circle 26.*

Formula 4000 desktop supermicrocomputer. Made for as many as 20 users, this computer offers 32-bit processing and runs under the Unix operating system. $9,900. Fortune Systems/SCI Technology Inc., 300 Harbor Blvd., Belmont, CA 94002. (415) 593-9000. *Circle 27.*

IC-1001 logic analyzer. Transforms an IBM PC-compatible computer or terminal into a logic analyzer for checking a variety of circuits. $269. Heath Co., Box 1288, Benton Harbor, MI 49022. (616) 982-3200. *Circle 28.*

Lasermax 40/50 roll feeder. An on-line roll feeder and form folder that works with such laser printers as the IBM 3800 and systems from Siemens, Univac, and Datagraphix. Price negotiable. Wallace Computer Services, 4600 W. Roosevelt Rd., Hillside, IL 60162. (312) 449-8600. *Circle 29.*

Model 60A memory adapter. This adapter lets the company's Model 60A logic programmer work on 120 popular EPROMs—double the number it normally supports. $2,495. Data I/O Corp., Box 97046, Redmond, WA 98073. (206) 881-6444. *Circle 30.*

Mors SR keyboard. Suited for IBM PC and Hull computers. This keyboard uses capacitance changes to trigger the circuit, thereby eliminating traditional metal-to-metal electrical contacts. Keys travel only two millimeters to permit faster typing. Price not available. French Technology Press Office, 401 N. Michigan Ave., Chicago, IL 60611. (312) 222-1235. *Circle 31.*

Performance 1000 modem. A 14.4-kilobit/second, full-duplex, leased-line modem. $1,795. Emulex Corp., Box 6725, Costa Mesa, CA 92626. (714) 662-5600. *Circle 32.*

Sun-3/60 desktop workstations. These stations run three million instructions/second. They offer memory-expansion options and eight-bit color display. $7,900 for the entry-level version; a color unit costs $9,900 and a stand-alone model is $12,900. Sun Microsystems, 2550 Garcia Ave., Mountain View, CA 94043. (415) 960-1300. *Circle 33.*

Turbo 386 accelerator card. Boosts the software performance of the 80286-based IBM PC/AT as much as 300 percent; also supports software developed for 80386 microprocessors. Includes a one-megabyte cache. $1,195. Advanced Digital Corp., 5432 Production Dr., Huntington Beach, CA 92649. (714) 891-4004. *Circle 34.*

VIP video-information processor. Adds full-motion picture capability to the company's Model 1500 workstation. Accepts NTSC level and CATV video signals. $9,995. NEC Information Systems Inc., 1414 Massachusetts Ave., Boxborough, MA 01719. (617) 264-8000. *Circle 35.*

VP240 color-video system. Processes color images from most video screens, transferring images to almost any color printer or plotter. $44.95. Graftel Systems Inc., 400 Executive Blvd., Elmsford, NY 10523. (914) 592-3700. *Circle 36.*

COMPUTER SOFTWARE

Inside Track II information tracker. Lets users of the IBM PC/XT/AT and compatible computers build personal databases by filling in forms. A city database comes with the program; other databases supplied by the company include the top 1,000 U.S. corporations. $100. I-Track Corp., 710 E. Plano Blvd., Suite 204, Plano, TX 75054. (214) 578-8140. *Circle 37.*

3+ network extension. Helps link Macintoshes with IBM PCs and compatible computers in a network. $495. 3Com, 3165 Kifer

Rd., Santa Clara, CA 95052. (408) 562-6400. *Circle 38.*

Byline desktop publisher. Enhances the quality of documents produced on the IBM PC. The program accepts files from dBase III Plus, Lotus 1-2-3, Symphony, and four paint programs. $295. Ashton-Tate Corp., 20101 Hamilton Ave, Torrance, CA 90502. (213) 329-8000. *Circle 39.*

Computer Industry Almanac database. A guide to the computer industry with about 750 listings; information on 400 companies includes executives and financial data. $49.95. I-Track Corp., 701 E. Park Blvd., Suite 204, Plano, TX 75074. (214) 578-8104. *Circle 40.*

DirWorks DOS shell. Helps manage files and directories, run programs, and control system functions using one-key commands and pop-up windows. $40. Keep It Simple Software Inc., 580 Fifth Ave, New York, NY 10036. (212) 764-5477. *Circle 41.*

Fastback hard-disk backup. This package uses error-correction techniques to recover data from damaged disks on the Macintosh 512, 512E, 512 Plus, SE, and Macintosh II. $99.95. Fifth Generation Systems, 1120 Industriplex Blvd., Baton Rouge, LA 70809. (504) 291-7221. *Circle 42.*

HomeWorks mortgage calculator. Computes loan-amortization schedules and affordability according to the rules of most banks. $40. Keep It Simple Software Inc., 580 Fifth Ave, New York, NY 10036. (212) 764-5744. *Circle 43.*

IrrWorks finance analyzer. Computes internal rates of return, plus present and future value for corporate cash flow, real estate, and investments. $89. Keep It Simple Software Inc., 580 Fifth Ave., New York, NY 10036. (212) 764-5477. *Circle 44.*

MenuWorks menu customizer. Lets nonexperts edit menus, specify colors, control time and date formats, and create passwords and help messages. $40. Keep It Simple Software Inc., 580 Fifth Ave, New York, NY 10036. (212) 764-5477. *Circle 45.*

Paradox database manager. Runs on the IBM PC and compatible computers; accommodates single or multiple users. $725. Ingram Software, 2128 Elmwood Ave., Buffalo, NY 14207. (716) 874-1874. *Circle 46.*

Patent Manager program. Handles patent docketing, correspondence, tracking, and reporting. From $18,000. Sotas Inc., 192 Merrimack St., Haverhill, MA 01830. (617) 372-0770. *Circle 47.*

SD-Tuner expert system. Gives advice about tuning DEC VAX/VMS systems to improve performance. Collects statistics on the system's page manager, input/output system, and cache. From $1,495. Systems Designers International Inc., 5203 Leesburg Pike, Falls Church, VA 22041. (800) 888-9988; in VA, (703) 820-2700. *Circle 48.*

Seekit information retriever. An add-on system that lets personal-computer users retrieve files from dBase III Plus, Clipper, or FoxBase environments. $99.95. Integrated Data Technologies Inc., 4813 Springfield Ave., Philadelphia, PA 19143. (800) 542-2400; in PA, (215) 726-6124. *Circle 49.*

Time Line project manager. Running on the IBM PC and compatible computers as well as on the Hewlett-Packard 150, this software offers resource leveling, partial resource allocation, and lead/lag scheduling. $99. Symantec, Breakthrough Software Div., 505-B San Marin Dr., Novato, CA 94945. (415) 898-1919. *Circle 50.*

Utilog I computer-use tracker. Monitors the use of IBM PCs or compatible computers and generates reports. $39.95. Benta, 12708 E. 62nd Court, Kansas City, MO 64133. (816) 353-3765. *Circle 51.*

World Community database. Presents information on 95 countries, including political, geographic, economic, and demographic characteristics. Helps students discover patterns, trends, and interrelationships among nations. Runs on Apple II systems with 64 kilobytes of memory. $55. MECC, 3490 Lexington Ave. N., Saint Paul, MN 55126. (612) 481-3500. *Circle 52.*

■ INDUSTRIAL/MANUFACTURING

LTS-2700 switch-test board. Checks the dc parameters of analog switches and multiplexers; also tests current leakage. Works with the company's LTS-2000 testers. From $5,500. Analog Devices Inc., Applications Engineering, 2 Technology Dr., Andover, MA 01810. (617) 794-8330. *Circle 53.*

HP 88780A ½-inch-tape drive. Automatically loads 6- to 10½-inch tape reels with 98-percent success. $7,020 each in lots of 1,000. Hewlett-Packard Co., 700 71st Ave., Greeley, CO 80634. (301) 670-4300. *Circle 54.*

Instant-Expert Plus shell. Helps develop expert systems by offering natural-language rule entry, interactive graphics, variables, and 18 inference-engine search strategies. $498. Human Intellect Systems, 1670 S. Amphlett Blvd., Suite 326, San Mateo, CA 94402. (415) 571-5939. *Circle 55.*

PA dispensing system. A computer-controlled system that measures out materials with an accuracy of 1/100 of a gram. Price varies. PA Technology, Princeton Laboratories, 279 Princeton Rd., Hightstown, NJ 08520. (609) 426-4700. *Circle 56.*

Power 45 computer. Includes a CRT display, two fixed or removable disk drives, and a ½-inch reel-to-reel magnetic-tape unit. Also provides eight communications channels, two megabytes of main memory, and three languages. $72,800. Modular Computer Systems Inc., Box 6099, Fort Lauderdale, FL 33340. (305) 974-1823. *Circle 57.*

PS-488 interface. This board and software library works with IBM's PS/2 architecture to control peripheral devices through the IEEE-488 bus. The interface offers direct access from high-level languages, plus on-board memory. $495. Capital Equipment Corp., 99 S. Bedford St., #107, Burlington, MA 01803. (617) 273-1818. *Circle 58.*

R2000 digital-storage oscilloscope. A two-channel scope that runs at 20 MHz and uses an IBM PC or compatible computer for display and storage. Less than $3,500. Rapid Systems Inc., 433 N. 34th St., Seattle, WA 98103. (206) 547-8311. *Circle 59.*

Symbad/OED, Symbad/PED programs. This software helps designers lay out integrated circuits. The OED program speeds layout drawing; the PED package tailors areas of a circuit design. $30,000 each. Ecad Inc., 2455 Augustine Dr., Santa Clara, CA 95054. (408) 727-0624. *Circle 60.*

VersaCAD/Machintosh software. Computer-aided design software for all Macintosh personal computers. The two-dimensional system has a floating-point accuracy of 16 decimal digits, an unlimited symbols library, and 250 drawing levels. Translation files link with desktop-publishing, painting, and finite-element-analysis systems. $1,995. Versacad Corp., 7372 Prince Dr., Huntington Beach, CA 92647. (714) 847-9960. *Circle 61.*

Xcell+ modeling/animation software. Combines a menu-driven model builder with a manufacturing simulator to let users analyze aternative system designs. $8,000. Pritsker & Associates Inc., Box 2413, West Lafayette, IN 47906. (800) 428-7636; in IN, (317) 463-5557. *Circle 62.*

XR-2130 modem chip. A 1200-bit/second modem on a chip; works with such microcontrollers as Zilog's CMOS Z-8. $21 each in lots of 100. Exar, Box 49007, San Jose, CA 95161. (408) 434-6400. *Circle 63.* ■

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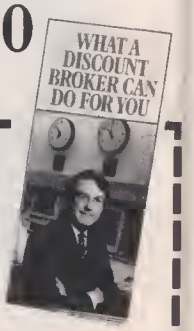

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OFFICE

Fashion Macs Fit Into Any Decor

NOW THAT computers have become *de rigueur* on a manager's desk, people are moving to integrate them into even the most imaginative decorating schemes. Entrepreneur David Siegel began by applying a quartz-look finish to his own Apple Macintosh. At the urging of friends, he founded Aesthetics Technology in January, and since then the new company has converted "dozens and dozens" of Macintosh computers. Siegel's *objets d'art* now include other computers, video cassette recorders, and compact-disc players.

Working by order only, the company strips the plastic shells from the terminal, hard drive, keyboard, and mouse (a procedure that voids the Apple warranty). The shells are cleaned and sanded, then coated with polyurethane so paint will adhere to the surface.

MONICA LEE

Siegel's well-dressed Macintoshes.

Although Siegel has applied some custom finishes, most of his computer-cabinet conversions follow standard designs. For example, a Mac can be dressed to look like granite (the most popular style) for $350, or like marble or wood for $895.

Aesthetics Technology is located at 365 Forest, Suite 4E, Palo Alto, CA 94301. Telephone (415) 326-3936.

HOME

Smart Home Talks Back

SO-CALLED "smart" houses not only think for their residents, they can now talk to them. A new computerized home-management system called Max can follow orders telephoned to it from anywhere in the world. Special codes entered through the telephone keypad let homeowners check or change settings. For example, a family member can call in to turn down the heat or get telephone messages. But Max is discriminating; it requires security codes and will not follow commands from an unauthorized caller.

Max incorporates an intercom system that's installed throughout the house. Not only can family members speak through the intercom, but Max can use it to deliver messages. The system also includes a terminal so homeowners can program Max's operations.

STEVEN MARK NEEDHAM

Home controller can be programmed by telephone.

Like other smart-house systems, Max, made by Archinetics of Portland, Ore., manages security, environment, energy, appliances, telephones, and more. Prices start at $8,000.

Archinetics will not have the market to itself, however. In 1988, Unity Systems of Redwood City, Calif., plans to offer a revised version of its Home Manager in the same price range as Max. Plans call for a modem and possibly voice-recognition features.

HOME

Computers Eye the Weather

EXECUTIVES who like to keep the company plane warmed up may profit from the PC Weather Pro, a product that turns an IBM-compatible personal computer into a weather station. A valuable tool for sailors and other weather watchers, the product has been applied by some heavy-duty industrial customers; automobile companies, for instance, use it to monitor conditions around test tracks.

The kit, which sells for $575, includes a plug-in computer card that contains software and a solid-state barometer. An electronic rain collector automatically drains and resets itself, and the kit also has an anemometer (wind-speed cups), a wind vane, two temperature probes, and connecting cables.

The station monitors and stores measurements of barometric pressure, rainfall, wind speed, and both actual and wind-chill temperatures. It creates a file for each day's data to help spot and analyze weather trends. Measurements are recorded every 30 minutes, whether the computer is running Lotus 1-2-3, Space Invaders, or any other program. Roughly a year's worth of weather information can be stored on one standard diskette.

Technology Marketing, which distributes the kit, expects a small but steady market of about 300 units a month. The company is located at 4000 Kruse Way Place, Lake Oswego, OR 97035. Telephone (503) 635-3966. ■

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